



Docket No.: NIH-0127
Inventor: Mario H. Skiadopoulos et al.
Title: ATTENUATED HUMAN-BOVINE
CHIMERIC PARAINFLUENZA VIRUS (PIV)
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Serial No.: 09/900,112 Filing Date: July 5, 2001

SEQ ID NO: 35

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ACCAAACAAG AGAAGAGACT TGCTTGGGAA TATTAAT TCA AATAAAAATT AACTTAGGAT 60
TAAAGAACTT TACCGAAAGG TAAGGGGAAA GAAATCC TAA GACTGTAATC ATGTTGAGTC 120
TATTCGACAC ATTCAGTGCG CGTAGGCAGG AGAACATAAC GAAATCAGCT GGTGGGGCTG 180
TTATTTCCCG GCAAAAAAAC ACTGTGTCTA TATTTGCTCT TGGACCATCA ATAACAGATG 240
ACAATGATAA AATGACATTG GCTCTTCTCT TTTTGTCTCA TTCTTTAGAC AATGAAAAGC 300
AGCATGCGCA AAGAGCTGGA TTTTAGTTT CTCTGTTATC AATGGCTTAT GCCAACCCAG 360
AATTATATTT AACATCAAAT GGTAGTAATG CAGATGT TAA ATATGTTATC TACATGATAG 420
AGAAAAGCCC AGGAAGACAG AAATATGGTG GGT TTGTCGT CAAGACTAGA GAGATGTTT 480
ATGAAAAGAC AACTGATTGG ATGTTCCGGA GTGATCT TGA GTATGATCAA GACAA TATGT 540
TGCAAAATGG TAGAAGCACT TCTACAATCG AGGATCT TGT TCATACTTTT GGATA TCCAT 600
CGTGTCTTGG AGCCCTTATA ATCCAAGTTT GGATAA TACT TGTTAAGGCT ATAAC CAGTA 660
TATCAGGATT GAGGAAAGGA TTCTTTACTC GGTTAGAAGC ATTTGACAA GATGGAACAG 720
TTAAATCCAG TCTAGTGTTG AGCGGTGATG CAGTAGAACA AATGGATCA ATTATGAGGT 780
CCCAACAGAG CTTGGTAACA CTCATGGTTG AAACACTGAT AACAA TGAAC ACAGGCAGGA 840
ATGATCTGAC AACAATAGAA AAGAATATAC AGATTGTAGG AAAC TACATC AGAGATGCAG 900
GTCTTGCTTC ATTTTTCAAC ACAATCAGAT ATGGCAT TGA GACTAGAATG GCAGC TCTAA 960
CTCTGTCTAC CCTTAGACCG GATATCAACA GACTCAAGGC ACTGATCGAG TTATATCTAT 1020
CAAAGGGGCC ACGTGCTCCT TTTATATGCA TTTTGAGAGA TCCCGTGCAT GGTGAGTTTG 1080
CACCAGGCAA CTATCCTGCC CTCTGGAGTT ATGCGATGGG TGTCAGATT GTACAAAACA 1140
AGGCCATGCA ACAGTATGTA ACAGGAAGGT CTTATCTGGA TATTGAAATG TTCCA ACTTG 1200
GTCAAGCAGT GGCACGTGAT GCCGAGTCGC AGATGAG TTC AATATTAGAG GATGA ACTGG 1260
GGGTACACA AGAAGCCAAG CAAAGCTTGA AGAAACACAT GAAGAACATC AGCAGTTCAG 1320
ATACAACCTT TCATAAGCCT ACAGGGGGAT CAGCCATAGA AATGGCGATA GATGAAGAAG 1380
CAGGGCAGCC TGAATCCAGA GGAGATCAGG ATCAAGGAGA TGAGCCTCGG TCATC CATAG 1440
TTCCTTATGC ATGGGCAGAC GAAACCGGGA ATGACAA TCA AACTGAATCA ACTACAGAAA 1500
TTGACAGCAT CAAAAC TGAA CAAAGAAACA TCAGAGACAG GCTGAACAAA AGACTCAACG 1560
AGAAAAGGAA ACAGAGTGAC CCGAGATCAA CTGACATCAC AAACAACACA AATCAA ACTG 1620
AAATAGATGA TTTGTT CAGT GCATTCCGAA GCAACTAGTC ACAAAGAGAT GACCACTATC 1680
ACCAGCAACA AGTAAGAAAA ACTTAGGATT AATGGAAATT ATCCAATCCA GAGACGGAAG 1740
GACAAATCCA GAATCCAACC ACAACTCAAT CAACCAAAGA TTCATGGAAG ACAATGTTCA 1800
AAACAATCAA ATCATGGATT CTTGGGAAGA GGGATCAGGA GATAAATCAT CTGACATCTC 1860
ATCGGCCCTC GACATCATTG AATTCATACT CAGCACC GAC TCCCAAGAAA ACACG GCAGA 1920
CAGCAATGAA ATCAACACAG GAACCACAAG ACTTAGCAGC ACAATCTACC AACCTGAATC 1980
CAAAACAACA GAAACAAGCA AGGAAAATAG TGGACCA GCT AACAAAAATC GACAGTTTGG 2040
GGCATCACAC GAACGTGCCA CAGAGACAAA AGATAGAAAT GTTAATCAGG AGACTGTACA 2100
GGGAGGATAT AGGAGAGGAA GCAGCC CAGA TAGTAGAACT GAGACTATGG TCACTCGAAG 2160
AATCTCCAGA AGCAGCCCAG ATCCTAACAA TGGAACCCAA ATCCAGGAAG ATATTGATTA 2220
CAATGAAGTT GGAGAGATGG ATAAGGACTC TACTAAGAGG GAAATGCGAC AATTTAAAGA 2280
TGTTCCAGTC AAGGTATCAG GAAGTGATGC CATTCTCCA ACAAACAAG ATGGAGACGG 2340
TGATGATGGA 2350
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FIGURE 1A



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AGAGGCCTGG AATCTATCAG TACATTTGAT TCAGGATATA CCAGTATAGT GACTGCCGCA 2410
ACACTAGATG ACGAAGAAGA ACTCCTTATG AAGAACAACA GGCCAAGAAA GTATCAATCA 2470
ACACCCCGAGA ACAGTGACAA GGAATTAAA AAAGGGGTTG GAAGGCCAAA AGACACAGAC 2530
AAACAATCAT CAATATTGGA CTACGAACTC AACTTCAAAG GATCGAAGAA GAGCCAGAAA 2590
ATCCTCAAAG CCAGCACGAA TACAGGAGAA CCAACAAGAC CACAGAATGG ATCCCAGGGG 2650
AAGAGAATCA CATCCTGGAA CATCCTCAAC AGCGAGAGCG GCAATCGAAC AGAATCAACA 2710
AACCACAAACC ATCAGACATC AACCTCGGGA CAGAACCACA CAATGGGACC AAGCAGAACA 2770
ACCTCCGAAC CAAGGATCAA GACACAAAAG ACGGATGGAA AGGAAAGAGA GGACACAGAA 2830
GAGAGCACTC GATTTACAGA AAGGGCGATT ACATTATTAC AGAATCTTGG TGTAATCCAA 2890
TCTGCAGCAA AATTAGACCT ATACCAAGAC AAGAGAGTTG TGTGTGTGGC GAATGTCCTA 2950
AACAAATGCAG ATACTGCATC AAAGATAGAC TTCCTAGCAG GTTTGATGAT AGGAGTGTCA 3010
ATGGATCATG ATACCAAAT AAATCAGATT CAGAACGAGA TATTAAGTTT GAAAACTGAT 3070
CTTAAAAAGA TGGATGAATC ACATAGAAGA CTAATTGAGA ATCAAAAAGA ACAATATCA 3130
CTGATCACAT CATTAACTCT AAATCTTAAA ATTATGACAG AGAGAGGAGG GAAGAAGGAC 3190
CAACCAGAAC CTAGCGGGAG GACATCCATG ATCAAGACAA AAGCAAAGA AGAGAAAATA 3250
AAGAAAGTCA GGTTTGACCC TCTTATGGAA ACACAGGGCA TCGAGAAAAA CATCCCTGAC 3310
CTCTATAGAT CAATAGAGAA AACACCAGAA AACGACACAC AGATCAAATC AGAAATAAAC 3370
AGATTGAATG ATGAATCCAA TGCCACTAGA TTAGTACCTA GAAGAATAAG CAGTACAATG 3430
AGATCATTAA TAATAATCAT TAACAACAGC AATTTATCAT CAAAAGCAAA GCAATCATAC 3490
ATCAACGAAC TCAAGCTCTG CAAGAGTGAC GAGGAAGTGT CTGAGTTGAT GGACATGTTT 3550
AATGAGGATG TCAGCTCCCA GTAAACCGCC AACCAAGGGT CAACACCAAG AAAACCAATA 3610
GCACAAAACA GCCAATCAGA GACCACCCCA ATACACCAA CCAATCAACA CATAACAAAG 3670
ATCTCCAGAT CATAGATGAT TAAGAAAAAC TTAGGATGAA AGGACTAATC AATCTCCGA 3730
AACAAATGAGC ATCACCAACT CCACAATCTA CACATTCCTA GAATCCTCTT TCTCCGAGAA 3790
TGGCAACATA GAGCCGTTAC CACTCAAGGT CAATGAAAG AGAAAGGCCA TACCTCATAT 3850
TAGGGTTGTC AAGATAGGAG ATCCGCCCAA ACATGGATCC AGATATCTGG ATGTCTTTTT 3910
ACTGGGCTTC TTTGAGATGG AAAGGTCAA AGACAGGTAT GGGAGCATAA GTGATCTAGA 3970
TGATGATCCA AGTTACAAGG TTTGTGGCTC TGGATCATG CCACTTGGGT TGGCTAGATA 4030
CACCGGAAAT GATCAGGAAC TCCTACAGGC TGCAACCAAG CTCGATATAG AAGTAAGAAG 4090
AACTGTAAAG GCTACGGAGA TGATAGTTTA CACTGTACAA AACATCAAAC CTGAACTATA 4150
TCCATGGTCC AGTAGATTAA GAAAAGGGAT GTTATTTGAC GCTAATAAGG TTGCACTTGC 4210
TCCTCAATGT CTTCCACTAG ATAGAGGGAT AAAATTCAGG GTGATATTTG TGAATGCAC 4270
AGCAATTGGA TCAATAACTC TATTCAAAT CCCTAAGTCC ATGGCATTGT TATCATTTGCC 4330
TAATACAATA TCAATAAATC TACAAGTACA TATCAAAACA GGAGTTCAGA CAGATCCAA 4390
AGGAGTAGTT CAGATTCTAG ATGAAAAAGG TGAAAAA TCACTAAATTTCA TGGTTCATCT 4450
CGGGTTGATC AAAAGGAAGA TGGGCAGAAT GTACTCAGTT GAATATTGTA AGCAGAAGAT 4510
CGAGAAGATG AGATTATTAT TCTCATTGGG ATTAGTTGGA GGGATCAGCT TCCACGTCAA 4570
CGCAACTGGC TCTATATCAA AGACATTAGC AAGTCAATTA GCATTCAAAA GAGAAATCTG 4630
CTATCCCTA ATGGATCTGA ATCCACACTT AAATTCAGTT ATATGGGCAT CATCAGTTGA 4690
AATTACAAGG 4700

FIGURE 1B



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GTAGATGCAG TTCTCCAGCC TTCATTACCT GGCGAATTCA GATACTACCC AAACATCATA 4760
GCAAAAGGGG TCGGGAAAA T CAGACAGTAA AATCAACAAC CCTGATATCC AACAT TGCAA 4820
ATCAGGCTAC CCACAGGAGA AAAATCAAAA ACTTAGGATC AAAGGGATCA CCACGAACCC 4880
CGGAAAACAG CCAAACAAAC CAACACACAA ATCACAGACA AAAAGGAGAA GGC ACTGCAA 4940
AGACCGAGAA AAAACAGAAC GCACACAACC AAGCAGAGAA AAGCCAAAGC CCGCCATTCA 5000
CAACACACCC AACAATCCTG CAAACAAGCA CCAAACAGA GGTCAAAGA CAAAGAGCAC 5060
CAGATATGAC CATCACAACC ACAATCATAG CCATATTACT AATACCCCA TCATT TTGTC 5120
AAATAGACAT AACAAACTG CAACGTGTAG GTGTGTAGT CAACAATCCT AAAGGCATGA 5180
AGATTTTACA AAATTTGGA ACGAGATACC TGATATT AAG TTTGATACCC AAAATAGAGA 5240
ATTCACACTC ATGTGGGGAT CAACAGATAA ACCAATACAA GAAGTTATTG GATAGATTGA 5300
TAATTCCTCT ATATGATGGA TTAATAATTAC AAAAAGATGT AATAGTAGTA AGTCATGAAA 5360
CCCACAACAA TACTAATCTT AGGACAAAAC GATTCTT TGG AGAGATAATT GGGACAATTG 5420
CGATAGGGAT AGCCACTTCA GCACAAATCA CCGCAGCAGT CGCTCTTGTC GAAGC TAAAC 5480
AGGCAAAGTC AGACATAGAA AAACCTCAAAG AGGCTAT AAG AGACACAAAC AAGGCAGTAC 5540
AATCGATTCA AAGTTCTGTA GGTAACTTAA TTGTTGCAGT TAAATCAGT CAAGACTATG 5600
TCAACAATGA AATTATACCT TCAATCACAA GATTAGGCTG TGAAGCAGCA GGGTTACAAT 5660
TGGGAATTGC ATTGACACAA CATTACTCAG AATTAACAAA TATATTGGT GATAATATAG 5720
GAACACTGAA AGAAAAAGGG ATAAAAATTAC AAGGGATAGC ATCATTATAT CACACAAACA 5780
TAACGGAAAT ATTTACTACT TCAACAGTTG ACCAATATGA TATTTATGAC CTATTATTCA 5840
CTGAGTCAAT CAAGATGAGA GTGATAGATG TTGATTTGAG TGATTACTCA ATTACTCTTC 5900
AAGTTAGACT TCCTTTATTA ACTAACTAT CAAATACTCA AATTTATAAA GTAGATTCTA 5960
TATCATACAA CATCCAGGGC AAAGAGTGGT ATATTCCTCT TCCCAATCAC ATCATGACAA 6020
AAGGGGCTTT TCTAGGTGGT GCTGATATTA AAGAATGCAT AGAGGCATTC AGCAGTTATA 6080
TATGTCCTTC TGATCCAGGT TACATATTAA ATCAGGAGAT AGAGAATTGT TTATCAGGGA 6140
ACATAACACA GTGTCTAAG ACTGTTGTTA CATCAGATGT GGTACCACGA TACGCGTTTG 6200
TGAATGGTGG ATTAATTGCA AACTGCATAA CAACTACATG TACATGCAAT GGAAT TGACA 6260
ATAGAATTAA TCAATCACCT GATCAAGGAA TTAAGATCAT AACACATAAA GAATGCCAGG 6320
TAATAGGTAT AAACGGAATG TTATTCAATA CTAATAGAGA AGGGACATTA GCAACTTATA 6380
CATTTGATGA CATCATATTA AATAACTCTG TTGCACTTAA TCCAA TTGAT ATATCTATGG 6440
AACTCAACAA GGCAAACTA GAATTAGAAG AATCGAAGGA ATGGATAAAG AAATCAAATC 6500
AAAAGTTAGA TTCCGTTGGA AGTTGGTATC AATCTAGTGC AACAAATCACC ATAATCATAG 6560
TGATGATAAT AATTCTAGTT ATAATCAATA TAACAAT TAT TGTAGTCATA ATCAAATTCC 6620
ATAGAATTCA GGGGAAAGAT CAAAACGACA AAAACAGTGA GCCGTATATA CTGACAAATA 6680
GACAATAAGA CTATACACGA TCAAAATATAA AAAGTACAAA AAACCTTAGGA ACAAAGTTGT 6740
TCAACACAGC AGCACC GAAT AGACCAAAAG GCAGCGCAGA GGCGACACCA AACTCAAAAA 6800
TGGAATATTG GAAACACACA AACAGCATAA ATAAACACCA CAATGAAACC GAAACAGCCA 6860
GAGGCAACA TAGTAGCAAG GTTACAAATA TCATAAT GTA CACCTTCTGG ACAATAACAT 6920
TAACAATATT ATCAGTCATT TTTATAATGA TATTGACAAA CTTAATTCAA GAGAACAAATC 6980
ATAATAAATT AATGTTGCAG GAAATAAGAA AAGAATT CGC GGCAATAGAC ACCAAGATTTC 7040
AGAGGACTTC 7050

FIGURE 1C



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GGATGACATT GGAACCTCAA TACAGTCAGG AATAAATACA AGACTTCTCA CAATT CAGAG 7110
TCATGTTCAA AACTATATCC CACTATCATT AACACAA CAA ATGTCAGATC TCAGAAAATT 7170
TATCAATGAT CTAACAAATA AAAGAGAACA TCAAGAA GTG CCAATACAGA GAATGACTCA 7230
TGATAGAGGT ATAGAACCCC TAAATCCAAA CAAGTTCTGG AGGTGTACAT CTGGTAACCC 7290
ATCTCTAACA AGTAGTCCTA AGATAAGGTT AATACCAGGA CCAGGTTTAT TAGCAACATC 7350
TACTACAGTA AATGGCTGTA TTAGAATTCC ATCGTTAGTA ATCAATCATC TAATC TATGC 7410
TTACACCTCT AATCTTATTA CCCAGGGCTG TCAAGATATA GGGAAATCTT ACCAAGTACT 7470
ACAAATAGGG ATAATTACTA TAAATTCGGA CCTAGTACCT GATTTAAACC CCAGAGTCAC 7530
ACATACATTT AATATTGATG ATAATAGAAG ATCTTGCTCT CTGGCACTAT TGAATACAGA 7590
TGTTTATCAG TTATGCTCAA CACCAAAAGT TGATGAAAGA TCCGATTATG CATCAACAGG 7650
TATTGAGGAT ATTGTACTTG ACATTGTCAC TAATAATGGA TTAATTATAA CAACAAGGTT 7710
TACAAATAAT AATATAACTT TTGATAAACC GTATGCAGCA TTGTATCCAT CAGTGGGACC 7770
AGGAATCTAT TATAAGGATA AAGTTATATT TCTCGGATAT GGAGGTCTAG AGCATGAAGA 7830
AAACGGAGAC GTAATATGTA ATACAACTGG TTGTCCTGGC AAAACACAGA GAGACTGTAA 7890
TCAGGCTTCT TATAGCCCAT GGTTCCTCAA TAGGAGAATG GTAAACTCTA TTATTGTTGT 7950
TGATAAAGGC ATAGATGCAA CTTTTAGCTT GAGGGTG TGG ACTATTCCAA TGAGCCAAAA 8010
TTATTGGGGA TCAGAAGGAA GATTACTTTT ATTAGGTGAC AGAATATACA TATATACTAG 8070
ATCCACAAGT TGGCACAGTA AATTACAGTT AGGGGTAATT GATATTTCTG ATTATACTAA 8130
TATAAGAATA AATTGGACTT GGCATAATGT ACTATCAGG CCAGGGAATG ATGAATGTCC 8190
ATGGGGTCAT TCATGCCAG ACGGATGTAT AACAGGAGTT TACACTGATG CATATCCGCT 8250
AAACCCATCG GGGAGTGTTG TATCATCAGT AATTCTTGAT TCACAAAAGT CTAGAGAAAA 8310
CCCAATCATT ACTTACTCAA CAGCTACAAA TAGAATAAAT GAATTAGCTA TATATAACAG 8370
AACACTTCCA GCTGCATATA CAACAACAAA TTGTATCACA CATTATGATA AAGGGTATTG 8430
TTTTCATATA GTAGAAATAA ATCAGAGAAG TTGGAATACG TTTCAACCTA TGTTATTCAA 8490
AACAGAAGTT CCAAAAAACT GCAGCTAAAT TGATCATCGC ATATCGGATG CAAGATGACA 8550
TTAAAGAGA CCACCAGACA GACAACACAG GAGACGATGC AAGATATAAA GAAATAATAA 8610
AAAACCTTAGG AGAAAAGTGT GCAAGAAAAA TGGACACCGA GTCCACACAGC GGCACAACAT 8670
CTGACATTCT GTACCCTGAA TGTCACCTCA ATTCTCCTAT AGTTAAAGGA AAGATAGCAC 8730
AACTGCATAC AATAATGAGT TTGCCTCAGC CCTACGATAT GGATGATGAT TCAATACTGA 8790
TTATTACTAG ACAAAAAAT T AACTCAATA AATTAGATAA AAGACAACGG TCAAT TAGGA 8850
AATTAAGATC AGTCTTAATG GAAAGAGTAA GTGATCTAGG TAAATATACC TTTATCAGAT 8910
ATCCAGAGAT GTCTAGTGAA ATGTTCCAAT TATGTATACC CGGAATTAAT AATAAAATAA 8970
ATGAATTGCT AAGTAAAGCA AGTAAACAT ATAATCAAAT GACTGATGGA TTAAGAGATC 9030
TATGGGTTAC TATACTATCG AAGTTAGCAT CGAAAAATGA TGGAAAGTAAT TATGATATCA 9090
ATGAAGATAT TAGCAATATA TCAATGTTC ACATGACTTA TCAATCAGAC AAATGGTATA 9150
ATCCATTCAA GACATGGTTT ACTATTAAGT ATGACATGAG AAGATTACAA AAAGCCAAAA 9210
ATGAGATTAC ATTCAATAGG CATAAAGATT ATAATCTATT AGAAGACCAA AAGAA TATAT 9270
TGCTGATACA TCCAGAACTC GTCTTAATAT TAGATAAACA AAATTACAAT GGGTATATAA 9330
TGACTCCTGA ATTGGTACTA ATGTATTGTG ATGTAGT TGA AGGGAGGTGG AATATAAGTT 9390
CATGTGCAAA 9400

FIGURE 1D



SEQ ID NO: 35

ATTGGATCCT AAGTTACAAT CAATGTATTA TAAGGGTAAC AATTTATGGG AAATAATAGA 9460
TGGACTATTC TCGACCTTAG GAGAAAGAAC ATTTGACATA ATATCACTAT TAGAACCACT 9520
TGCATTATCG CTCATTCAAA CTTATGACCC GGTAAAA CAG CTCAGGGGGG CTTTT TAAA 9580
TCACGTGTTA TCAGAAATGG AATTAATATT TGCAGCTGAG TGTACAACAG AGGAAATACC 9640
TAATGTGGAT TATATAGATA AAATTTTAGA TGTGTTCAA GAATCAACAA TAGATGAAAT 9700
AGCAGAAATT TTCTCTTCT TCCGAACCTT TGGACAC CCT CCATTAGAGG CGAGTATAGC 9760
AGCAGAGAAA GTTAGAAAGT ATATGTATAC TGAGAAA TGC TTGAAATTTG ATACTATCAA 9820
TAAATGTCAT GCTATTTTT GTACAATAAT TATAAATGGA TATAGAGAAA GACATGGTGG 9880
TCAATGGCCT CCAGTTACAT TACCTGTCCA TGCACAT GAA TTTATCATAA ATGCATACGG 9940
ATCAAATTCT GCCATATCAT ATGAGAATGC TGTAGAT TAT TATAAGAGCT TCATAGGAAT 10000
AAAATTTGAC AAGTTTATAG AGCCTCAATT GGTAGAA GAC TTAATTTTT ATATGAAAGA 10060
TAAAGCATT TCCCAAAGA AATCAAATG GGACACAGTC TATCCAGCTT CAAACCTGTT 10120
ATACCGCACT AATGTGTCTC ATGATTCACG AAGATTGTT GAAGTATTTA TAGCAGATAG 10180
TAAATTTGAT CCCCAACAAG TATTAGATTA CGTAGAATCA GGATATTGGC TGGATGATCC 10240
TGAATTTAAT ATCTCATATA GTTTAAAGA GAAAGAAATA AAACAAGAAG GTAGACTTTT 10300
TGCAAAAATG ACATACAAGA TGAGGGCTAC ACAAGTATTA TCAGAAACAT TATTGCGGAA 10360
TAATATAGGG AAATCTTCC AAGAGAATGG GATGGTTAAA GGAGAAATTG AATTACTCAA 10420
GAGACTAACA ACAATATCTA TGTCTGGAGT TCCGCGGTAT AATGAGGTAT ACAATAATTC 10480
AAAAAGTCAC ACAGAAGAAC TTCAAGCTTA TAATGCAATT AGCAGTTCCA ATTTATCTTC 10540
TAATCAGAAG TCAAAGAAGT TTGAATTTAA ATCTACAGAT ATATACAATG ATGGATACGA 10600
AACCCTAAGC TGCTTCTTAA CGACAGATCT TAAAAAATAT TGTTTAAATT GGAGGTATGA 10660
ATCAACAGCT TTATCGGTG ATACTTGTA TCAGATATTT GGGTTAAAGG AATTATTTAA 10720
TTGGCTGCAC CCTCGCCTTG AAAAGAGTAC AATATATGTT GGAGATCCTT ATTGCCCGCC 10780
ATCAGATATT GAACATTTAC CACTTGATGA CCATCCTGAT TCAGGATTTT ATGTT CATAA 10840
TCCTAAAGGA GGAATAGAAG GGTTTTGCCA AAAGTTATGG AACTCATAT CTATCAGTGC 10900
AATACATTTA GCAGCTGTCA AAATCGGTGT AAGAGTTACT GCAATGGTTC AAGGGGATAA 10960
TCAAGCCATA GCTGTTACCA CAAGAGTACC TAATAAT TAT GATTATAAAG TTAAGAAAGA 11020
GATTGTTTAT AAAGATGTGG TAAGATTTTT TGATTCC TTG AGAGAGGTGA TGGATGATCT 11080
GGGTCATGAG CTCAACTAA ATGAACTAT AATAAGTAGT AAAA TGTTTA TATATAGCAA 11140
AAGGATATAC TATGACGGAA GAATCCTTCC TCAGGCATTA AAAGCATTGT CTAGATGTGT 11200
TTTTTGGTCT GAAACAATCA TAGATGAGAC AAGATCAGCA TCCTCAAATC TGGCTACATC 11260
GTTTGCAAAG GCCATTGAGA ATGGCTACTC ACCTGTATTG GGATATGTAT GCTCAATCTT 11320
CAAAAATATC CAACAGTTGT ATATAGCGCT TGGAAATGAAT ATAAACCCAA CTATAACCCA 11380
AAATATTTAA GATCAATATT TCAGGAATAT TCATTGGATG CAATATGCCT CCTTAATCCC 11440
TGCTAGTGTC GGAGGATTTA ATTATATGGC CATGTCAAGG TGTTTTGTCA GAAACATTGG 11500
AGATCCTACA GTCGCTGCGT TAGCCGATAT TAAAAGATTT ATAAAAGCAA ATTTGTTAGA 11560
TCGAGGTGTC CTTTACAGAA TTATGAATCA AGAACCAGGC GAGTCTTCTT TTTAGACTG 11620
GGCCTCAGAT CCCTATTCAT GTAACCTACC ACAATCTCAA AATATAACCA CCATGATAAA 11680
GAATATAACT GCAAGAAATG TACTACAGGA CTCACCAAAC CCATTACTAT CTGGATTATT 11740
TACAAGTACA 11750

FIGURE 1E



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ATGATAGAAG AGGATGAGGA ATTAGCTGAG TTCCTAATGG ACAGGAGAAT AATCC TCCCA 11810
AGAGTTGCAC ATGACATTTT AGATAATTCT CTTACTGGAA TTAGGAATGC TATAGCTGGT 11870
ATGTTGGATA CAACAAAATC ACTAATTCGA GTAGGGA TAA GCAGAGGAGG ATTAACCTAT 11930
AACTTATTAA GAAAGATAAG CAACTATGAT CTTGTACAAT ATGAGACACT TAGTAAAACT 11990
TTAAGACTAA TAGTCAGTGA CAAGATTAAG TATGAAGATA TGTGCTCAGT AGACC TAGCC 12050
ATATCATTAA GACAAAAAT GTGGATGCAT TTATCAGGAG GAAGAATGAT AAATGGACTT 12110
GAAACTCCAG ATCCTTTAGA GTTACTGTCT GGAGTAA TAA TAACAGGATC TGAACATTGT 12170
AGGATATGTT ATTCAACTGA AGGTGAAAGC CCATATACAT GGATGTATTT ACCAGGCAAT 12230
CTTAATATAG GATCAGCTGA GACAGGAATA GCATCAT TAA GGGTCCCTTA CTTTG GATCA 12290
GTTACAGATG AGAGATCTGA AGCACAATTA GGGTATA TCA AAAATCTAAG CAAAC CAGCT 12350
AAGGCTGCTA TAAGAATAGC AATGATATAT ACTTGGGCAT TTGGGAATGA CGAAATATCT 12410
TGGATGGAAG CATCACAGAT TGCACAAACA CGTGCAA ACT TTACATTGGA TAGCT TAAAG 12470
ATTTTGACAC CAGTGACAAC ATCAACAAAT CTATCACACA GGTAAAAGA TACTGCTACT 12530
CAGATGAAAT TTTCTAGTAC ATCACTTATT AGAGTAAGCA GGTTCATCAC AATATCTAAT 12590
GATAATATGT CTATTAAAGA AGCAAATGAA ACTAAAGATA CAAATCTTAT TTATCAACAG 12650
GTAATGTTAA CAGGATTAAG TGTATTGAA TATCTATTTA GGTTAGAGGA GAGTACAGGA 12710
CATAACCCTA TGGTCATGCA TCTACATATA GAGGATG GAT GTTGATATAA AGAGAGTTAC 12770
AATGATGAGC ATATCAATCC GGAGTCTACA TTAGAGTTAA TCAAATACCC TGAGAGTAAT 12830
GAATTTATAT ATGATAAGGA CCCTTTAAAG GATATAGATC TATCAAAATT AATGGTTATA 12890
AGAGATCATT CTTATACAA TGCATGAAT TACTGGGATG ACACAGATAT TGTACATGCA 12950
ATATCAATAT GTACTGCAGT TACAATAGCA GATACAA TGT CGCAGCTAGA TCGGGATAAT 13010
CTTAAGGAGC TGGTTGTGAT TGCAAATGAT GATGATATTA ACAGTCTGAT AACTGAA TTT 13070
CTGACCCTAG ATATACTAGT GTTTCTCAA ACATTGAG GGTACTCGT GAATCAATTT 13130
GCATATACCC TTTATGGAT GAAAATAGAA GGAAGGGATC CCATTGCGGA TTATA TAATG 13190
AGAACATTAA AAGACACCTC ACATTCAGTA CTTAAAGTAT TATCTAATGC ACTATCTCAT 13250
CCAAAGTGT TTAAGAGAT TTTGGGATTGT GGAGTTT TGA ATCCTATTTA TGGTCTAAT 13310
ACTGCTAGTC AAGATCAAGT TAAGCTTGCT CTCTCGATTT GCGAGTACTC CTTGGATCTA 13370
TTTATGAGAG AATGGTTGAA TGGAGCATCA CTTGAGATCT ATATCTGTGA TAGTGACATG 13430
GAAATAGCAA ATGACAGAAG ACAAGCATT CTCTCAAGAC ATCTTGCCCT TGTGTGTTGT 13490
TTAGCAGAGA TAGCATCTTT TGGACCAAAT TTATTAAATC TAACATATCT AGAGAGACTT 13550
GATGAATTAA AACAATACTT AGATCTGAAC ATCAAAGAAG ATCCTACTCT TAAATATGTG 13610
CAAGTATCAG GACTGTAA TAAATCATTC CCCTCAACTG TTACGTATGT AAGGAAA ACT 13670
GCGATTAAGT ATCTGAGGAT TCGTGGTATT AATCCGCCTG AAACGATTGA AGATTGGGAT 13730
CCCATAGAAG ATGAGAATAT CTTAGACAAT ATTGTTAAAA CTGTAAATGA CAATTGCAGT 13790
GATAATCAAA AGAGAAATAA AAGTAGTTAT TTCTGGGGAT TAGCTCTAAA GAATTATCAA 13850
GTCGTGAAAA TAAGATCCAT AACGAGTGAT TCTGAAGTTA ATGAAGCTTC GAATGTTACT 13910
ACACATGGAA TGACACTTCC TCAGGGAGGA AGTTATCTAT CACATCAGCT GAGGTATTTT 13970
GGAGTAAACA GTACAAGTTG TCTTAAAGCT CTTGAAT TAT CACAAATCTT AATGAGGGAA 14030
GTTAAAAAAG ATAAAGATAG ACTCTTTTTA GGAGAAGGAG CAGGAGCTAT GTTAGCATGT 14090
TATGATGCTA 14100

FIGURE 1F



Docket No.: NIH-0127
Inventor: Mario H. Skiadopoulos et al.
Title: ATTENUATED HUMAN-BOVINE
CHIMERIC PARAINFLUENZA VIRUS (PIV)
VACCINES Page 7 of 27
Serial No.: 09/900,112 Filing Date: July 5, 2001

SEQ ID NO: 35

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CACTCGGTCC TGCAATAAAT TATTATAATT CTGGTTTAAA TATTACAGAT GTAAT TGGTC 14160
AACGGGAATT AAAAATCTTC CCATCAGAAG TATCATTAGT AGGTAAAAAA CTAGGAAATG 14220
TAACACAGAT TCTTAATCGG GTGAGGGTGT TATTTAATGG GAATCCCAAT TCAACATGGA 14280
TAGGAAATAT GGAATGTGAG AGTTTAATAT GGAGTGAATT AAATGATAAG TCAATTGGTT 14340
TAGTACATTG TGACATGGAG GGAGCGATAG GCAAAATCAGA AGAAACTGTT CTACA TGAAC 14400
ATTATAGTAT TATTAGGATT ACATATTTAA TCGGGGA TGA TGATGTTGTC CTAGTATCAA 14460
AAATTATACC AACTATTACT CCGAATTGGT CTAATAACT CTATCTATAC AAGTTGTATT 14520
GGAAGGATGT AAGTGTAGTG TCCCTTAAAA CATCCAATCC TGCCTCAACA GAGCTTTATT 14580
TAATTTCAAA AGATGCTTAC TGTACTGTAA TGGAACCCAG TAATCTTGTT TTATCAAAAC 14640
TTAAAAGGAT ATCATCAATA GAAGAAAATA ATCTATTAAA GTGGATAATC TTATCAAAAA 14700
GGAAGAATAA CGAGTGGTTA CAGCATGAAA TCAAAGAAGG AGAAAGGGAT TATGGGATAA 14760
TGAGGCCATA TCATACAGCA CTGCAAATTT TTGGATTCCA AATTAACCTA AATCACTTAG 14820
CTAGAGAATT TTTATCAACT CCTGATTTAA CCAACAT TAA TAATATAATT CAAAGTTTAA 14880
CAAGAACAAT TAAAGATGTT ATGTTTCAAT GGGTCAA TAT CACTCATGAC AATAAAAGAC 14940
ATAAATTAGG AGGAAGATAT AATCTATTCC CGCTTAAAAA TAAGGGGAAA TTAAGATTAT 15000
TATCACGAAG ATTAGTACTA AGCTGGATAT CATTATCCTT ATCAACCAGA TTACTGACGG 15060
GCCGTTTTTC AGATGAAAAA TTTGAAAATA GGGCACAGAC CGGATATGTA TCATTGGCTG 15120
ATATTGATTT AGAATCCTTA AAGTTATTAT CAAGAAATAT TGTCAAAAAT TACAAAGAAC 15180
ACATAGGATT AATATCATACT TGGTTTTTGA CCAAAGAGGT CAAAATACTA ATGAAGCTTA 15240
TAGGAGGAGT CAAACTACTA GGAATTCCTA AACAGTACAA AGAGTTAGAG GATCGATCAT 15300
CTCAGGGTTA TGAATATGAT AATGAATTTG ATATTGATTA ATACATAAAA ACATAAAAATA 15360
AAACACCTAT TCCTCACCCA TTCACTTCCA ACAAATGAA AAGTAAGAAA AACATGTAAT 15420
ATATATATAC CAAACAGAGT TTTTCTCTTG TTTGGT 15456
```

FIGURE 1G



SEQ ID NO: 36

ACCAAACAAG AGAAGAGACT TGCTTGGGAA TATTAAT TCA AATAAAAAATT AACTTAGGAT 60
TAAAGAACTT TACCGAAAGG TAAGGGGAAA GAAATCC TAA GACTGTAATC ATGTTGAGTC 120
TATTCGACAC ATTCACTGCG CGTAGGCAGG AGAACAT AAC GAAATCAGCT GGTGGGGCTG 180
TTATTCCCGG GCAAAAAAAC ACTGTGTCTA TATTGCTCT TGGACCATCA ATAACAGATG 240
ACAATGATAA AATGACATTG GCTCTTCTCT TTTTGTCTCA TTCTTTAGAC AATGAAAAGC 300
AGCATGCGCA AAGAGCTGGA TTTTAGTTT CTCTGTTATC AATGGCTTAT GCCAACCCAG 360
AATTATATTT AACATCAAA TGGTAGTAATG CAGATGT TAA ATATGTTATC TACATGATAG 420
AGAAAGACCC AGGAAGACAG AATATGGTG GGTTTGT CGT CAAGACTAGA GAGATGGTTT 480
ATGAAAAGAC AACTGATTGG ATGTTCTGGA GTGATCT TGA GTATGATCAA GACAAATATG 540
TGCAAAATGG TAGAAGCACT TCTACAATCG AGGATCT TGT TCATACTTTT GGATA TCCAT 600
CGTGTCTTGG AGCCCTTATA ATCCAAGTTT GGATAATACT TGTTAAGGCT ATAACCAGTA 660
TATCAGGATT GAGGAAAGGA TTCTTTACTC GGTTAGAAGC ATTCGACAA GATGGAACAG 720
TTAAATCCAG TCTAGTGTG AGCGGTGATG CAGTAGAACA AATTGGATCA ATTATGAGGT 780
CCCAACAGAG CTTGTAACA CTCATGGTTG AAACACT GAT AACAATGAAC ACAGGCAGGA 840
ATGATCTGAC AACAATAGAA AAGAATATAC AGATTGTAGG AACTACATC AGAGATGCAG 900
GTCTTGCTTC ATTTTTC AAC AATCAGAT ATGGCAT TGA GACTAGAATG GCAGCTCTAA 960
CTCTGTCTAC CCTTAGACCG GATATCAACA GACTCAAGGC ACTGATCGAG TTATACTAT 1020
CAAAGGGGCC ACGTGCTCT TTTATATGCA TTTTGAGAGA TCCCGTGCAT GGTGAGTTG 1080
CACCAGGCAA CTATCCTGCC CTCTGGAGTT ATGCGATGGG TGAGCAGTT GTACAAAACA 1140
AGGCCATGCA ACAGTATGTA ACAGGAAGGT CTTATCTGGA TATTGAAATG TTCCAATTG 1200
GTCAAGCAGT GGCACGTGAT GCCGAGTCGC AGATGAGTTC AATATTAGAG GATGAACTGG 1260
GGGTACACA AGAAGCCAAG CAAAGCTTGA AGAAACACAT GAAGAACATC AGCAGTTCAG 1320
ATACAACCTT TCATAAGCCT ACAGGGGGAT CAGCCATAGA AATGGCGATA GATGAAGAAG 1380
CAGGGCAGCC TGAATCCAGA GGAGATCAGG ATCAAGGAGA TGAGCCTCGG TCATCATAG 1440
TTCTTATGC ATGGGCAGAC GAAACCGGGA ATGACAATCA AACTGAATCA ACTACAGAAA 1500
TTGACAGCAT CAAACTGAA CAAAGAAACA TCAGAGACAG GCTGAACAAA AGACTCAACG 1560
AGAAAAGGAA ACAGAGTGAC CCGAGATCAA CTGACATCAC AAACAACACA AATCAAAGTG 1620
AAATAGATGA TTTGTTGAGT GCATTCGGAA GCAACTAGTC ACAAAGAGAT GACCACTATC 1680
ACCAGCAACA AGTAAGAAAA ACTTAGGATT AATGGAAATT ATCCAATCCA GAGACGGAAG 1740
GACAAATCCA GAATCCAACC ACAACTCAAT CAACCAAAGA TTCATGGAAG ACAATGTTCA 1800
AAACAATCAA ATCATGGATT CTTGGGAAGA GGGATCAGGA GATAAATCAT CTGACATCTC 1860
ATCGGCCCTC GACATCATTG AATTCATACT CAGCACCGAC TCCCAAGAAA ACACGGCAGA 1920
CAGCAATGAA ATCAACACAG GAACCACAAG ACTTAGCAGC ACAATCTACC AACCTGAATC 1980
CAAAACAACA GAAACAAGCA AGGAAAATAG TGGACCAGCT AACAAAAATC GACAGTTTGG 2040
GGCATCACAC GAACGTGCCA CAGAGACAAA AGATAGAAAT GTTAATCAGG AGACTGTACA 2100
GGGAGGATAT AGGAGAGGAA GCAGCCGAGA TAGTAGAACT GAGACTATGG TCACTCGAAG 2160
AATCTCCAGA AGCAGCCGAG ATCCTAACAA TGGAACCAA ATCCAGGAAG ATATTGATTA 2220
CAATGAAGTT GGAGAGATGG ATAAGGACTC TACTAAGAGG GAAATGCGAC AATTTAAAGA 2280
TGTTCCAGTC AAGGTATCAG GAAGTGATGC CATTCTCCA ACAAACAAG ATGGAGACGG 2340
TGATGATGGA 2350

FIGURE 2A



SEQ ID NO: 36

AGAGGCCTGG AATCTATCAG TACATTTGAT TCAGGATATA CCAGTATAGT GACTGCCGCA 2410
ACACTAGATG ACGAAGAAGA ACTCCTTATG AAGAACAACA GGCCAAGAAA GTATCAATCA 2470
ACACCCAGAG ACAGTGACAA GGAATTAAA AAAGGGGTTG GAAGGCCAAA AGACACAGAC 2530
AAACAATCAT CAATATTGGA CTACGAACCT AACTTCAAAG GATCGAAGAA GAGCCAGAAA 2590
ATCCTCAAAG CCAGCACGAA TACAGGAGAA CCAACAAGAC CACAGAATGG ATCCCAGGGG 2650
AAGAGAATCA CATCCTGGAA CATCTCAAC AGCGAGAGCG GCAATCGAAC AGAATCAACA 2710
AACCAAACCC ATCAGACATC AACCTCGGGA CAGAACCACA CAATGGGACC AAGCAGAACA 2770
ACCTCCGAAC CAAGGATCAA GACACAAAAG ACGGATGGA AGGAAAGAGA GGACACAGAA 2830
GAGAGCACTC GATTTACAGA AAGGGCGATT ACATTAT TAC AGAATCTTGG TGTAATCCAA 2890
TCTGCAGCAA AATTAGACCT ATACCAAGAC AAGAGAGTTG TGTGTGTGGC GAATGTCCTA 2950
AACAATGCAG ATACTGCATC AAAGATAGAC TTCTAGCAG GTTTGATGAT AGGAGTGTCA 3010
ATGGATCATG ATACCAAATT AAATCAGATT CAGAACGAGA TATTAAGTTT GAAAACTGAT 3070
CTTAAAAAGA TGGATGAATC ACATAGAAGA CTAATTGAGA ATCAAAAAGA ACAAT TATCA 3130
CTGATCACAT CATTAACTC AAATCTTAAA ATTATGACAG AGAGAGGAGG GAAGAAGGAC 3190
CAACCAGAAC CTAGCGGGAG GACATCCATG ATCAAGACAA AAGCAAAAAGA AGAGAAAATA 3250
AAGAAAGTCA GGTTCGACCC TCTTATGGAA ACACAGGGCA TCGAGAAAAA CATCCCTGAC 3310
CTCTATAGAT CAATAGAGAA AACACCAGAA AACGACACAG AGATCAAATC AGAAA TAAAC 3370
AGATTGAATG ATGAATCCAA TGCCACTAGA TTAGTACCTA GAAGAATAAG CAGTACAATG 3430
AGATCATTAA TAATAATCAT TAACAACAGC AATTTATCAT CAAAAGCAAA GCAATCATAC 3490
ATCAACGAAC TCAAGCTCTG CAAGAGTGAC GAGGAAGTGT CTGAGTTGAT GGACATGTTT 3550
AATGAGGATG TCAGCTCCCA GTAAACCGCC AACCAAGGGT CAACACCAAG AAAACCAATA 3610
GCACAAAACA GCCAATCAGA GACCACCCCA ATACACC AAA CCAATCAACA CATAA CAAAG 3670
ATCTCCAGAT CATAGATGAT TAAGAAAAAC TTAGGATGAA AGGACTAATC AATCC TCCGA 3730
AACAATGAGC ATCACCAACT CCACAATCTA CACATTCCCA GAATCCTCTT TCTCCGAGAA 3790
TGGCAACATA GAGCCGTTAC CACTCAAGGT CAATGAACAG AGAAAGGCCA TACCTCATAT 3850
TAGGGTTGTC AAGATAGGAG ATCCGCCCAA ACATGGA TCC AGATATCTGG ATGTC TTTTT 3910
ACTGGGCTTC TTTGAGATGG AAAGGTCAA AGACAGGTAT GGGAGCATAA GTGATCTAGA 3970
TGATGATCCA AGTTACAAGG TTTGTGGCTC TGGATCATG CCACTTGGGT TGGCTAGATA 4030
CACCGGAAAT GATCAGGAAC TCCTACAGGC TGCAACCAAG CTCGATATAG AAGTAAGAAG 4090
AACTGTAAAG GCTACGGAGA TGATAGTTTA CACTGTACAA AACATCAAAC CTGAACTATA 4150
TCCATGGTCC AGTAGATTAA GAAAAGGGAT GTTATTTGAC GCTAATAAGG TTGCACTTGC 4210
TCCTCAATGT CTCCACTAG ATAGAGGGAT AAAATTCAGG GTGATATTG TGAAGTGCAC 4270
AGCAATTGGA TCAATAACTC TATTCAAAAT CCCTAAGTCC ATGGCATTGT TATCATTGCC 4330
TAATACAATA TCAATAAATC TACAAGTACA TATCAAAAACA GGAGTTCAGA CAGAT TCCAA 4390
AGGAGTAGTT CAGATTCTAG ATGAAAAAGG TGAAAAA TCA CTAAATTCA TGGTT CATCT 4450
CGGGTTGATC AAAAGGAAGA TGGGCAGAA GTACTCAGTT GAATATTGTA AGCAGAAGAT 4510
CGAGAAGATG AGATTATTAT TCTCATTGGG ATTAGTTGGA GGGATCAGCT TCCACGTCAA 4570
CGCAACTGGC TCTATATCAA AGACATTAGC AAGTCAATTA GCATTCAAAA GAGAAATCTG 4630
CTATCCCCTA ATGGATCTGA ATCCACACTT AAATTCAGTT ATATGGGCAT CATCAGTTGA 4690
AATTACAAGG 4700

FIGURE 2B



Docket No.: NIH-0127
Inventor: Mario H. Skiadopoulos et al
Title: ATTENUATED HUMAN-BOVINE
CHIMERIC PARAINFLUENZA VIRUS (PIV)
VACCINES Page 10 of 27
Serial No.: 09/900,112 Filing Date: July 5, 2001

SEQ ID NO: 36

GTAGATGCAG TTCTCCAGCC TTCATTACCT GGCGAAT TCA GATACTACCC AAACATCATA 4760
GCAAAAGGGG TCGGGAAAAAT CAGACAGTAA AATCAACAAC CCTGATATCC AACAT TGCAA 4820
ATCAGGCTAC CCACAGGAGA AAAATCAAAA ACTTAGGATC AAAGGGATCA CCACGAACCC 4880
CGGAAAACAG CCAAAACAAAC CAACACACAA ATCAGAGACA AAAAGGAGAA GGCACTGCAA 4940
AGACCGAGAA AAAACAGAAC GCACACAACC AAGCAGAGAA AAGCCAAAGC CCGCCATTCA 5000
CAAAACACACC AACATCCTG CAAACAAGCA CCAAAACAGA GGTCAAAGA CAAAGAGCAC 5060
CAGATATGAC CATCACAACC ACAATCATAG CCATATTACT AATACCCCA TCATT TTGTC 5120
AAATAGACAT AACAAAACCTG CAACGTGTAG GTGTGTTAGT CAACAATCCT AAAGGCATGA 5180
AGATTTTACA AAATTTGAA ACGAGATACC TGATATT AAG TTTGATACCC AAAATAGAGA 5240
ATTACACTC ATGTGGGGAT CAACAGATAA ACCAATAAA GAAGTTATTG GATAGATTGA 5300
TAATTCCTCT ATATGATGGA TTAAAATTAC AAAAGATGT AATAGTAGTA AGTCATGAAA 5360
CCCACAACAA TACTAATCTT AGGACAAAAC GATTCTT TGG AGAGATAATT GGGACAATTG 5420
CGATAGGGAT AGCCACTTCA GCACAAATCA CCGCAGCAGT CGCTCTTGTC GAAGCTAAAC 5480
AGGCAAAGTC AGACATAGAA AAACCTCAAAG AGGCTATAAG AGACACAAAC AAGGCAGTAC 5540
AATCGATTCA AAGTTCTGTA GGTAACCTAA TTGTTGCACT TAAATCAGTT CAAGACTATG 5600
TCAACAATGA AATTATACCT TCAATCACAA GATTAGGCTG TGAAGCAGCA GGGTTACAAAT 5660
TGGGAATTGC ATTGACACAA CATTACTCAG AATTAACAAA TATATTTGGT GATAATATAG 5720
GAACACTGAA AGAAAAAGGG ATAAAATTAC AAGGGATAGC ATCATTATAT CACACAAACA 5780
TAACGGAAAT ATTTACTACT TCAACAGTTG ACCAATA TGA TATTTATGAC CTATTATTCA 5840
CTGAGTCAAT CAAGATGAGA GTGATAGATG TTGATTGAG TGATTACTCA ATTACTCTTC 5900
AAGTTAGACT TCCTTTATTA ACTAACTAT CAAACTATCA AATTTATAAA GTAGATTCTA 5960
TATCATACAA CATCCAGGGC AAAGAGTGGT ATATTCCTCT TCCCAATCAC ATCATGACAA 6020
AAGGGGCTTT TCTAGGTGGT GCTGATATTA AAGAATGCAT AGAGGCATTG AGCAGTTATA 6080
TATGTCCTTC TGATCCAGGT TACATATTAA ATCAGAGAT AGAGAATTGT TTATCAGGGA 6140
ACATAACACA GTGTCCTAAG ACTGTTGTTA CATCAGATGT GGTACCACGA TACGCGTTTG 6200
TGAATGGTGG ATTAATTGCA AACTGCATAA CAACTACATG TACATGCAAT GGAATTGACA 6260
ATAGAATTAA TCAATCACCT GATCAAGGAA TTAAGATCAT AACACATAAA GAATGCCAGG 6320
TAATAGGTAT AAACGGAATG TTATTCAATA CTAATAGAGA AGGGACATTA GCAACTTATA 6380
CATTGATGA CATCATATTA AATAACTCTG TTGCACTTAA TCCAATTGAT ATATCTATGG 6440
AACTCAACAA GGCAAACTA GAATTAGAAG AATCGAAGGA ATGGATAAAG AAATCAAATC 6500
AAAAGTTAGA TTCCGTTGGA AGTTGGTATC AATCTAGTGC AACAAATCACC ATAATCATAG 6560
TGATGATAAT AATTCTAGTT ATAATCAATA TAACAATTAT TGTAGTCATA ATCAAATTCC 6620
ATAGAATTCA GGGGAAAGAT CAAAACGACA AAAACAGTGA GCCGTATATA CTGACAAATA 6680
GACAATAAGA CTATACACGA TCAATATAAA AAAGTACAAA AAACCTAGGA ACAAAGTTGT 6740
TCAACACAGC AGCACCGAAT AGACCAAAAG GCAGCGCAGA GGCGACACCA AACTCAAAAA 6800
TGGAATATTG GAAACACACA AACAGCATAA ATAACACCAA CAATGAAACC GAAACAGCCA 6860
GAGGCAAACA TAGTAGCAAG GTTACAAATA TCATAATGTA CACCTTCTGG ACAATAACAT 6920
TAACAAATATT ATCAGTCATT TTTATAATGA TATTGACAAA CTTAATTCAA GAGAACAAATC 6980
ATAATAAATT AATGTTGCAG GAAATAAGAA AAGAATTCGC GGCAATAGAC ACCAAGATTG 7040
AGAGGACTTC 7050

FIGURE 2C



Docket No.: NIH-0127
Inventor: Mario H. Skiadopoulos et al.
Title: ATTENUATED HUMAN-BOVINE
CHIMERIC PARAINFLUENZA VIRUS (PIV)
VACCINES Page 11 of 27
Serial No.: 09/900,112 Filing Date: July 5, 2001

SEQ ID NO: 36

GGATGACATT GGAACCTCAA TACAGTCAGG AATAAATACA AGACTTCTCA CAATT CAGAG 7110
TCATGTTCAA AACTATATCC CACTATCATT AACACAA CAA ATGTCAGATC TCAGAAAATT 7170
TATCAATGAT CTAACAAATA AAAGAGAACA TCAAGAA GTG CCAATACAGA GAATGACTCA 7230
TGATAGAGGT ATAGAACCCC TAAATCCAAA CAAGTTCTGG AGGTGTACAT CTGGTAACCC 7290
ATCTCTAACA AGTAGTCCTA AGATAAGGTT AATACCAGGA CCAGGTTTAT TAGCAACATC 7350
TACTACAGTA AATGGCTGTA TTAGAATTCC ATCGTTAGTA ATCAATCATC TAATC TATGC 7410
TTACACCTCT AATCTTATTA CCCAGGGCTG TCAAGATATA GGGAAATCTT ACCAAGTACT 7470
ACAAATAGGG ATAATTACTA TAAAT TCGGA CCTAGTACCT GATTTAAACC CCAGAGTCAC 7530
ACATACATTT AATATTGATG ATAATAGAAG ATCTTGC TCT CTGGCACTAT TGAATACAGA 7590
TGTTTATCAG TTATGCTCAA CACCAAAAGT TGATGAAAGA TCCGATTATG CATCAACAGG 7650
TATTGAGGAT ATTGTACTTG ACATTGTCAC TAATAAT GGA TTAATTATAA CAACAAGGTT 7710
TACAAATAAT AATATAACTT TTGATAAACC GTATGCAGCA TTGTATCCAT CAGTGGGACC 7770
AGGAATCTAT TATAAGGATA AAGTTATATT TCTCGGATAT GGAGGTCTAG AGCAT GAAGA 7830
AAACGGAGAC GTAATATGTA ATACAAC TGG TTGTCTT GGC AAAACACAGA GAGACTGTAA 7890
TCAGGCTTCT TATAGCCCAT GGTTCTCAA TAGGAGAATG GTAACTCTA TTATTGTTGT 7950
TGATAAAGGC ATAGATGCAA CTTTTAGCTT GAGGGTGTGG ACTATTCCAA TGAGCCAAAA 8010
TTATTGGGGA TCAGAAGGAA GATTACTTTT ATTAGGTGAC AGAATATACA TATATACTAG 8070
ATCCACAAGT TGGCACAGTA AATTACAGTT AGGGGTAATT GATATTTCTG ATTATACTAA 8130
TATAAGAATA AATTGGACTT GGCATAATGT ACTATCA CGG CCAGGGAATG ATGAATGTCC 8190
ATGGGGTCAT TCATGCCAG ACGGATGTAT AACAGGAGTT TACACTGATG CATAT CCGCT 8250
AAACCCATCG GGGAGTGTTG TATCATCAGT AATTCTT GAT TCACAAAAGT CTAGAGAAAA 8310
CCCAATCATT ACTTACTCAA CAGCTACAAA TAGAATAAAT GAATTAGCTA TATATAACAG 8370
AACACTTCCA GCTGCATATA CAACAACAAA TTGTATACA CATTATGATA AAGGGTATTG 8430
TTTTCATATA GTAGAAATAA ATCACAGAAG TTTGAAT ACG TTTCACCTA TGTATTCAA 8490
AACAGAAGTT CCAAAAAACT GCAGCTAAAT TGATCATCGC ATATCGGATG CAAGATGACA 8550
TTAAAAGAGA CCACCAGACA GACAACACAG GAGACGATGC AAGATATAAA GAAATAATAA 8610
AAAACTTAGG AGAAAAGTGT GCAAGAAAAA TGGACAC CGA GTCCACAGC GGCACAACAT 8670
CTGACATTCT GTACCCTGAA TGTACCTCA ATTCTCC TAT AGTTAAAGGA AAGATAGCAC 8730
AACTGCATAC AATAATGAGT TTGCCTCAGC CCTACGATAT GGATGATGAT TCAATACTGA 8790
TTATTACTAG ACAAAAAAT AACTCAATA AATTAGATAA AAGACAACGG TCAATTAGGA 8850
AATTAAGATC AGTCTTAATG GAAAGAGTAA GTGATCTAGG TAAATATACC TTTATCAGAT 8910
ATCCAGAGAT GTCTAGTGAA ATGTTCCAAT TATGTATACC CGGAATTAAT AATAAAATAA 8970
ATGAATTGCT AAGTAAAGCA AGTAAACAT ATAATCAAAT GACTGATGGA TTAAGAGATC 9030
TATGGGTTAC TATACTATCG AAGTTAGCAT CGAAAAA TGA TGGAAAGTAAT TATGATATCA 9090
ATGAAGATAT TAGCAATATA TCAATGTTC ACATGACTTA TCAATCAGAC AAATGGTATA 9150
ATCCATTCAA GACATGGTTT ACTATTAAGT ATGACATGAG AAGATTACAA AAAGCCAAAA 9210
ATGAGATTAC ATTCAATAGG CATAAAGATT ATAATCTATT AGAAGACCAA AAGAAATATAT 9270
TGCTGATACA TCCAGAACTC GTCTTAATAT TAGATAAACA AAATTACAAT GGGTATATAA 9330
TGACTCCTGA ATTGGTACTA ATGTATTGTG ATGTAGT TGA AGGGAGGTGG AATATAAGTT 9390
CATGTGCAAA 9400

FIGURE 2D



Docket No.: NIH-0127
Inventor: Mario H. Skiadopoulos et al.
Title: ATTENUATED HUMAN-BOVINE
CHIMERIC PARAINFLUENZA VIRUS (PIV)
VACCINES Page 12 of 27
Serial No.: 09/900,112 Filing Date: July 5, 2001

SEQ ID NO: 36

ATTGGATCCT AAGTTACAAT CAATGTATTA TAAGGGTAAC AATTTATGGG AAATAATAGA 9460
TGGACTATTC TCGACCTTAG GAGAAAGAAC ATTTGACATA ATATCACTAT TAGAACCACT 9520
TGCATTATCG CTCATTCAAA CTTATGACCC GGTAAACAG CTCAGGGGGG CTTTTTAA 9580
TCACGTGTTA TCAGAAATGG AATTAATATT TGCAGCTGAG TGTACAACAG AGGAAATACC 9640
TAATGTGGAT TATATAGATA AAATTTTAGA TGTGTTCAA GAATCAACAA TAGATGAAAT 9700
AGCAGAAATT TTCTCTTCT TCCGAACCTT TGGACACCCT CCATTAGAGG CGAGTATAGC 9760
AGCAGAGAAA GTTAGAAAGT ATATGTATAC TGAGAAA TGC TTGAAATTTG ATACTATCAA 9820
TAAATGTCAT GCTATTTTTT GTACAATAAT TATAAATGGA TATAGAGAAA GACATGGTGG 9880
TCAATGGCCT CCAGTTACAT TACCTGTCCA TGCACATGAA TTTATCATAA ATGCA TACGG 9940
ATCAAATTCT GCCATATCAT ATGAGAATGC TGTAGAT TAT TATAAGAGCT TCATAGGAAT 10000
AAAATTTGAC AAGTTTATAG AGCCTCAATT GGATGAAGAC TTAATATTTT ATATGAAAGA 10060
TAAAGCATT TCCCCAAAGA AATCAAATG GGACACAGTC TATCCAGCTT CAAACCTGTT 10120
ATACCGCACT AATGTGTCTC ATGATTCACG AAGATTGGTT GAAGTATTTA TAGCAGATAG 10180
TAAATTTGAT CCCCACCAAG TATTAGATTA CGTAGAA TCA GGATATTGGC TGGATGATCC 10240
TGAATTTAAT ATCTCATATA GTTTAAAGA GAAAGAAATA AAACAGAAG GTAGACTTTT 10300
TGCAAAATG ACATACAAGA TGAGGGCTAC ACAAGTATTA TCAGAAACAT TATTGCGGAA 10360
TAATATAGGG AAATCTTCC AAGAGAATGG GATGGTTAAA GGAGAAATG AATTA CTCAA 10420
GAGACTAACA ACAATATCTA TGTCTGGAGT TCCGCGG TAT AATGAGGTAT ACAATAATTC 10480
AAAAAGTCAC ACAGAAGAAC TTCAAGCTTA TAATGCAATT AGCAGTTCCA ATTTA CTCTC 10540
TAATCAGAAG TCAAAGAAGT TTGAATTTAA ATCTACAGAT ATATACAATG ATGGA TACGA 10600
AACCGTAAGC TGCTTCTTAA CGACAGATCT TAAAAAATAT TGTTTAAATT GGAGGTATGA 10660
ATCAACAGCT TTATTCGGTG ATACTGTGTA TCAGATATTT GGGTTAAAGG AATTATTTAA 10720
TTGGCTGCAC CCTCGCCTTG AAAAGAGTAC AATATATGTT GGAGATCCTT ATTGCCGCC 10780
ATCAGATATT GAACATTTAC CACTTGATGA CCATCCTGAT TCAGGATTTT ATGTT CATAA 10840
TCCTAAAGGA GGAATAGAAG GGTTTTGCCA AAAGTTATGG AACTCATAT CTATCAGTGC 10900
AATACATTTA GCAGCTGTCA AAATCGGTGT AAGAGTTACT GCAATGGTTC AAGGGGATAA 10960
TCAAGCCATA GCTGTTACCA CAAGAGTACC TAATAAT TAT GATTATAAAG TTAAGAAAGA 11020
GATTGTTTAT AAAGATGTGG TAAGATTTTT TGATTCC TTG AGAGAGGTGA TGGATGATCT 11080
GGGTCATGAG CTCAACTAA ATGAACTAT AATAAGTAGT AAAATGTTTA TATATAGCAA 11140
AAGGATATAC TATGACGGAA GAATCCTTCC TCAGGCATTA AAAGCATTGT CTAGATGTGT 11200
TTTTTGGTCT GAAACAATCA TAGATGAGAC AAGATCAGCA TCCTCAAATC TGGCTACATC 11260
GTTTGCAAAG GCCATTGAGA ATGGCTACTC ACCTGTATTG GGATATGTAT GCTCAATCTT 11320
CAAAAATATC CAACAGTTGT ATATAGCGCT TGGAATGAAT ATAAACCCAA CTATAACCCA 11380
AAATATTAAA GATCAATAT T TCAGGAATAT TCATTGGATG CAATATGCCT CCTTAATCCC 11440
TGCTAGTGTC GGAGGATTTA ATTATATGGC CATGTCAAGG TGTTTTGTCA GAAACATTGG 11500
AGATCCTACA GTCGCTGCGT TAGCCGATAT TAAAGATTT ATAAAGCAA ATTTGTTAGA 11560
TCGAGGTGTC CTTTACAGAA TTATGAATCA AGAACCAGGC GAGTCTTCTT TTTTAGACTG 11620
GGCCTCAGAT CCCTATTCTAT GTAACCTACC ACAATCT CAA AATATAACCA CCATGATAAA 11680
GAATATAACT GCAAGAAATG TACTACAGGA CTCACCAAAC CCATTACTAT CTGGATTATT 11740
TACAAGTACA 11750

FIGURE 2E



SEQ ID NO: 36

ATGATAGAAG AGGATGAGGA ATTAGCTGAG TTCCTAA TGG ACAGGAGAAT AATCC TCCCA 11850
AGAGTTGCAC ATGACATTTT AGATAATTCT CTTACTGGAA TTAGGAATGC TATAGCTGGT 11870
ATGTTGGATA CAACAAAATC ACTAATTCGA GTAGGGA TAA GCAGAGGAGG ATTAACCTAT 11930
AACTTATTAA GAAAGATAAG CAACTATGAT CTTGTACAAT ATGAGACACT TAGTAAACT 11990
TTAAGACTAA TAGTCAGTGA CAAGATTAAG TATGAAGATA TGTGCTCAGT AGACCTAGCC 12050
ATATCATTAA GACAAAAAAT GTGGATGCAT TTATCAG GAG GAAGAATGAT AAATGGACTT 12110
GAAACTCCAG ATCCTTTAGA GTTACTGTCT GGAGTAATAA TAACAGGATC TGAACATTGT 12170
AGGATATGTT ATTCAACTGA AGGTGAAAGC CCATATACAT GGATGTATTT ACCAGGCAAT 12230
CTTAATATAG GATCAGCTGA GACAGGAATA GCATCAT TAA GGGTCCCTTA CTTTGGATCA 12290
GTTACAGATG AGAGATCTGA AGCACAATTA GGGTATATCA AAAATCTAAG CAAAC CAGCT 12350
AAGGCTGCTA TAAGAATAGC AATGATATAT ACTTGGGCAT TTGGGAATGA CGAAATATCT 12410
TGGATGGAAG CATCACAGAT TGCACAAACA CGTGCAA ACT TTACATTGGA TAGCT TAAAG 12470
ATTTTGACAC CAGTGACAAC ATCAACAAAT CTATCACACA GGT TAAAGA TACTGCTACT 12530
CAGATGAAAT TTTCTAGTAC ATCACTTATT AGAGTAAGCA GGTTCATCAC AATATCTAAT 12590
GATAATATGT CTATTAAAGA AGCAAATGAA ACTAAAGATA CAAATCTTAT TTATCAACAG 12650
GTAATGT TAA CAGGATTAAG TGTATTTGAA TATCTAT TTA GGTTAGAGGA GAGTACAGGA 12710
CATAACCTTA TGGTCATGCA TCTACATATA GAGGATGGAT GTTGTATAAA AGAGAGTTAC 12770
AATGATGAGC ATATCAATCC GGAGTCTACA TTAGAGTTAA TCAAATACCC TGAGAGTAAT 12830
GAATTTATAT ATGATAAGGA CCCTTTAAAG GATATAGATC TATCAAAATT AATGGTTATA 12890
AGAGATCATT CTTATACAAT TGACATGAAT TACTGGGATG ACACAGATAT TGTACATGCA 12950
ATATCAATAT GTACTGCAGT TACAATAGCA GATACAA TGT CGCAGCTAGA TCGGGATAAT 13010
CTTAAGGAGC TGGTTGTGAT TGCAAATGAT GATGATATTA ACAGTCTGAT AACTGAATTT 13070
CTGACCCTAG ATATACTAGT GTTTCTCAAA ACATTTGGAG GGTTACTCGT GAATCAATTT 13130
GCATATACCC TTTATGGATT GAAAATAGAA GGAAGGGATC CCATTTGGGA TTATA TAATG 13190
AGAACATTAA AAGACACCTC ACATTCAGTA CTTAAAGTAT TATCTAATGC ACTATCTCAT 13250
CCAAAAGTGT TTAAGAGATT TTGGGATTGT GGAGTTT TGA ATCCTATTTA TGGTCTAAT 13310
ACTGCTAGTC AAGATCAAGT TAAGCTTGCT CTCTCGATTT GCGAGTACTC CTTGGATCTA 13370
TTTATGAGAG AATGGTTGAA TGGAGCATCA CTTGAGATCT ATATCTGTGA TAGTGACATG 13430
GAAATAGCAA ATGACAGAAG ACAAGCATTT CTCTCAAGAC ATCTTGCCCTT TGTGTGTTGT 13490
TTAGCAGAGA TAGCATCTTT TGGACCAAAT TTATTAAATC TAACATATCT AGAGAGACTT 13550
GATGAATTAA AACAATACTT AGATCTGAAC ATCAAAGAAG ATCCTACTCT TAAATATGTG 13610
CAAGTATCAG GACTGTAAAT TAAATCATTC CCCTCAACTG TTACGTATGT AAGGAAACT 13670
GCGATTAAGT ATCTGAGGAT TCGTGGTATT AATCCGCCTG AAACGATTGA AGATTGGGAT 13730
CCCATAGAAG ATGAGAATAT CTTAGACAAT ATTGTTAAAA CTGTAAATGA CAATTGCAGT 13790
GATAATCAAA AGAGAAATAA AAGTAGTTAT TTCTGGGGAT TAGCTCTAAA GAATTATCAA 13850
GTCGTGAAAA TAAGATCCAT AACGAGTGAT TCTGAAGTTA ATGAAGCTTC GAATGTTACT 13910
ACACATGGAA TGACACTTCC TCAGGGAGGA AGTTATCTAT CACATCAGCT GAGGTATTTT 13970
GGAGTAAACA GTACAAGTTG TCTTAAAGCT CTTGAAT TAT CACAAATCTT AATGAGGGAA 14030
GTTAAAAAAG ATAAAGATAG ACTCTTTTTA GGAGAAGGAG CAGGAGCTAT GTTAGCATGT 14090
TATGATGCTA 14100

FIGURE 2F



Docket No.: NIH-0127
Inventor: Mario H. Skiadopoulos et al.
Title: ATTENUATED HUMAN-BOVINE
CHIMERIC PARAINFLUENZA VIRUS (PIV)
VACCINES Page 14 of 27
Serial No.: 09/900,112 Filing Date: July 5, 2001

SEQ ID NO: 36

CACTCGGTCC	TGCAATAAAAT	TATTATAATT	CTGGTTTAAA	TATTACAGAT	GTAAT TGGTC	14160
AACGGGAATT	AAAAATCTTC	CCATCAGAAG	TATCATTAGT	AGGTAAAAAA	CTAGGAAATG	14220
TAACACAGAT	TCTTAATCGG	GTGAGGGTGT	TATTTAATGG	GAATCCCAAT	TCAACATGGA	14280
TAGGAAATAT	GGAATGTGAG	AGTTTAATAT	GGAGTGAATT	AAATGATAAG	TCAATTGGTT	14340
TAGTACATTG	TGACATGGAG	GGAGCGATAG	GCAAATCAGA	AGAAACTGTT	CTACATGAAC	14400
ATTATAGTAT	TATTAGGATT	ACATATTTAA	TCGGGGATGA	TGATGTTGTC	CTAGTATCAA	14460
AAATTATACC	AACTATTACT	CCGAATTGGT	CTAAAATACT	CTATCTATAC	AAGTTGTATT	14520
GGAAGGATGT	AAGTGTAGTG	TCCCTTAAAA	CATCCAATCC	TGCCTCAACA	GAGCTTTATT	14580
TAATTTCAAA	AGATGCTTAC	TGTACTGTAA	TGGAACCCAG	TAATCTTGTT	TTATCAAAAC	14640
TTAAAGGAT	ATCATCAATA	GAAGAAAATA	ATCTATTAAA	GTGGATAATC	TTATCAAAAA	14700
GGAAGAATAA	CGAGTGGTTA	CAGCATGAAA	TCAAAGAAGG	AGAAAGGGAT	TATGGGATAA	14760
TGAGGCCATA	TCATACAGCA	CTGCAAATTT	TTGGATTCCA	AATTAACTTA	AATCACTTAG	14820
CTAGAGAATT	TTTATCAACT	CCTGATTTAA	CCAACATTAA	TAATATAATT	CAAAGTTTTA	14880
CAAGAACAAT	TAAAGATGTT	ATGTTCGAAT	GGGTCAATAT	CACTCATGAC	AATAAAAGAC	14940
ATAAATTAGG	AGGAAGATAT	AATCTATTCC	CGCTTAAAAA	TAAGGGGAAA	TTAAGATTAT	15000
TATCACGAAG	ATTAGTACTA	AGCTGGATAT	CATTATCCTT	ATCAACCAGA	TTACTGACGG	15060
GCCGTTTTCC	AGATGAAAAA	TTTGAAAATA	GGGCACAGAC	CGGATATGTA	TCATTGGCTG	15120
ATATTGATTT	AGAATCCTTA	AAGTTATTAT	CAAGAAATAT	TGTCAAAAAT	TACAAAGAAC	15180
ACATAGGATT	AATATCATAC	TGGTTTTTGA	CCAAAGAGGT	CAAAATACTA	ATGAAGCTTA	15240
TAGGAGGAGT	CAAACTACTA	GGAATTCCTA	AACAGTACAA	AGAGTTAGAG	GATCGATCAT	15300
CTCAGGGTTA	TGAATATGAT	AATGAATTTG	ATATTGATTA	ATACATAAAA	ACATAAAATA	15360
AAACACCTAT	TCCTCACCCA	TTCACCTCCA	ACAAAATGAA	AAGTAAGAAA	AACATGTAAT	15420
ATATATATAC	CAAACAGAGT	TTTTCTCTTG	TTTGGT			15456

FIGURE 2G



FIG. 3A

Mutagenesis to create restriction sites at start and stop condons of N

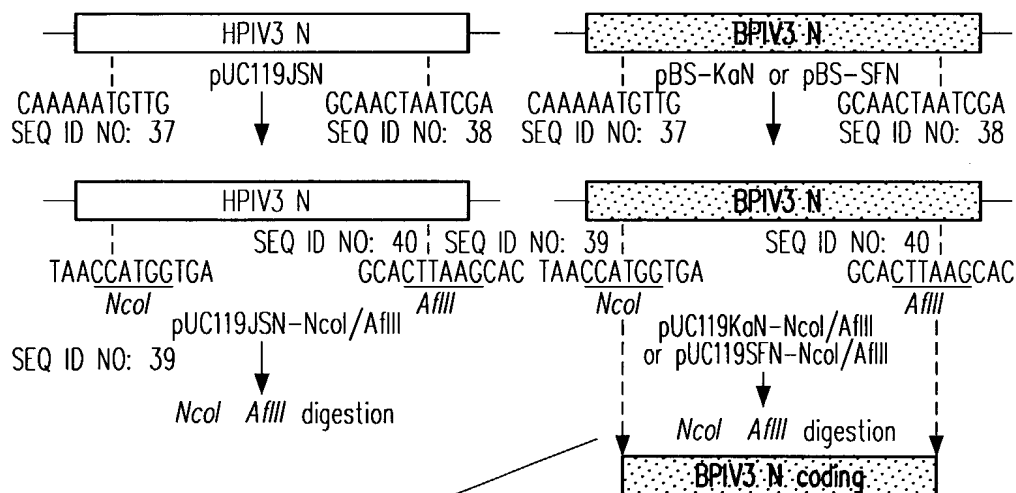


FIG. 3B

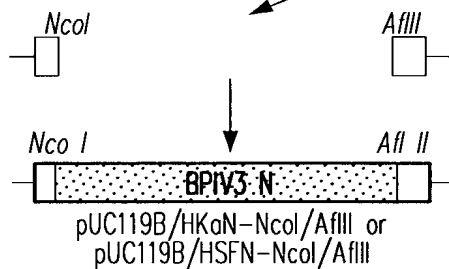
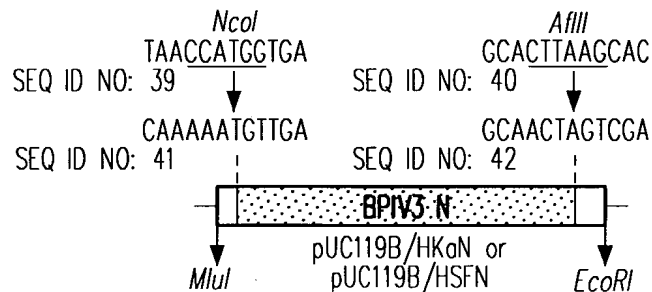


FIG. 3C

Mutagenesis to restore start and stop condon context



LEGEND

- BPIV3 sequence
- HPIV3 sequence



FIG. 4A

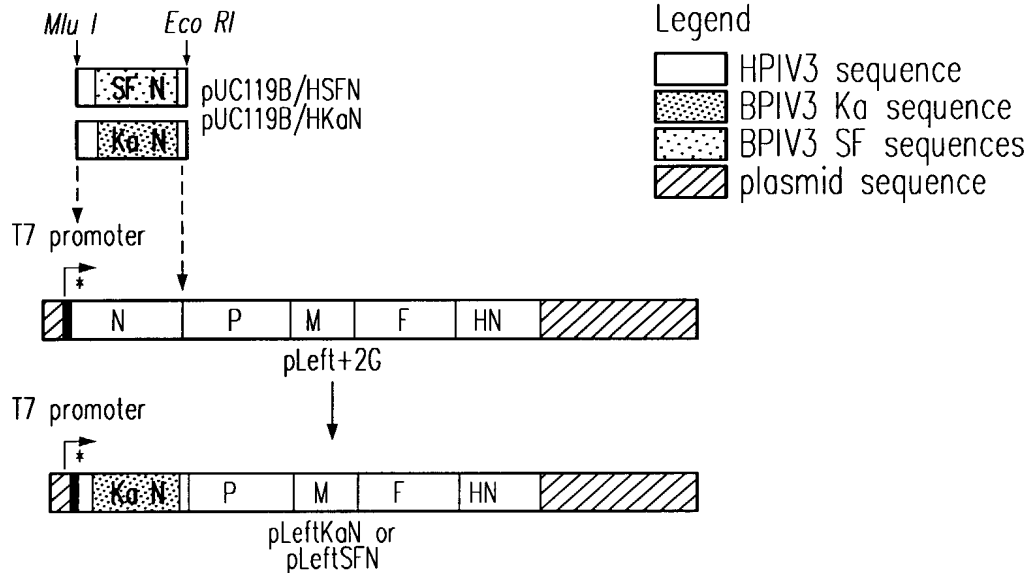


FIG. 4B

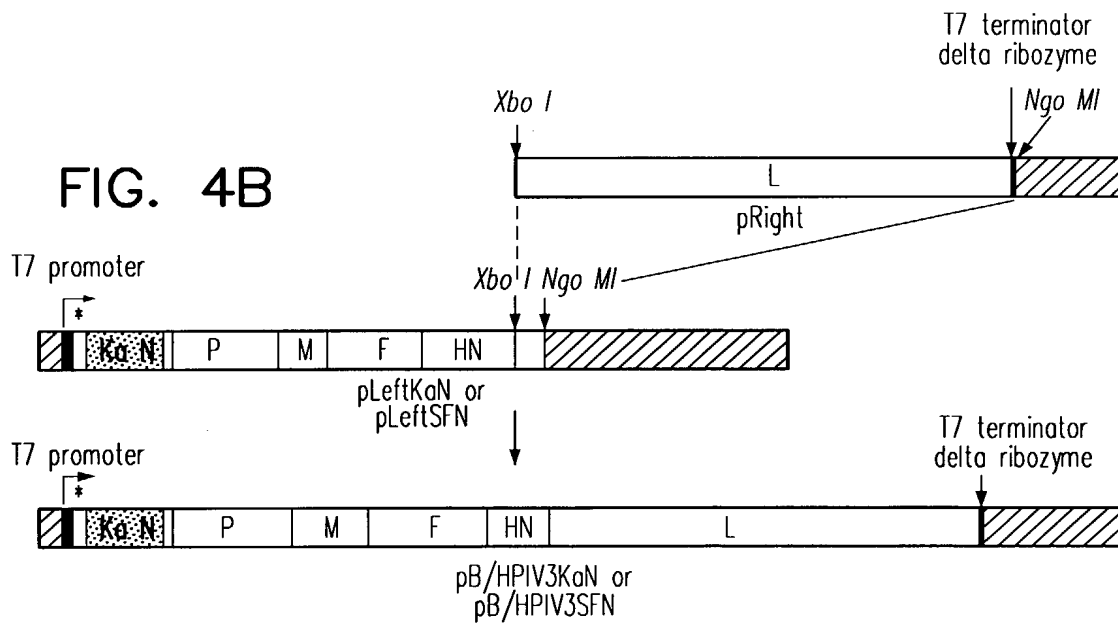




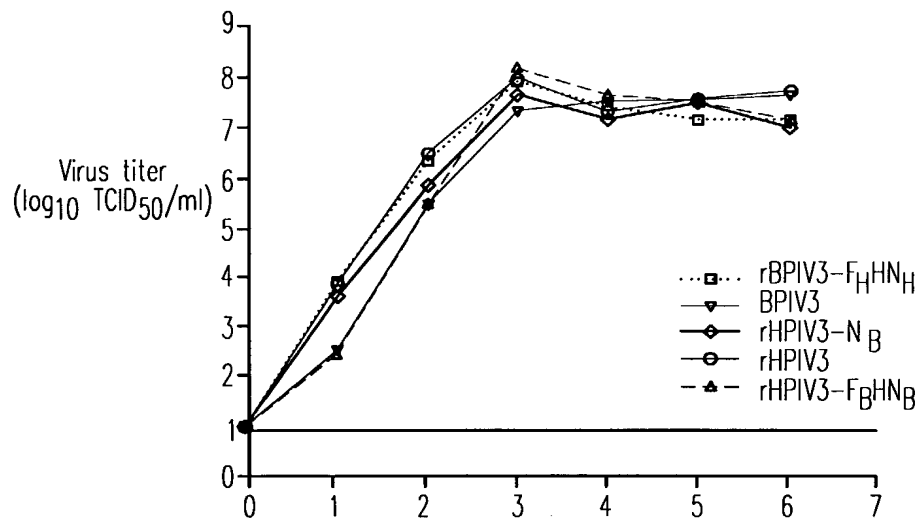
FIG. 5A

SEQ ID NO: 43	rJS	GGA	A	C	T	C	T	A	T	T	T	C	A	A	A	A	T	G	T	T	G	A	G	C	T	A	T	T	G	A	T	A	C			
SEQ ID NO: 44	cKa	GGA	A	C	T	C	T	A	T	T	T	C	A	A	A	A	T	G	T	T	G	A	G	T	C	T	A	T	T	C	G	A	C			
SEQ ID NO: 45	cSF	GGA	A	C	T	C	T	A	T	T	T	C	A	A	A	A	T	G	T	T	G	A	G	T	C	T	A	T	T	C	G	A	C			
SEQ ID NO: 46	Ka	GAA	A	T	C	C	T	A	A	G	A	C	T	G	T	A	A	T	C	A	T	G	T	T	G	A	G	T	C	A	T	T	C	G	A	C
SEQ ID NO: 47	SF	GAA	A	T	C	C	T	A	A	G	A	C	T	G	T	A	A	T	C	A	T	G	T	T	G	A	G	T	C	A	T	T	C	G	A	C

FIG. 5B

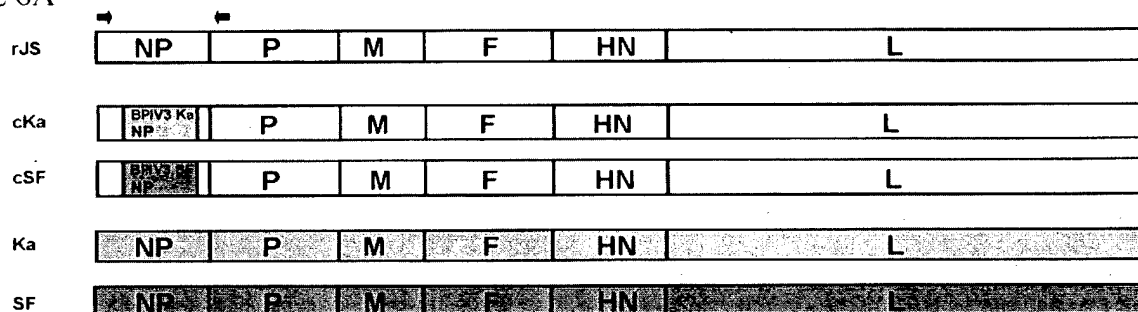
SEQ ID NO: 48	rJS	T	T	A	A	C	G	C	A	T	T	T	G	G	A	G	C	A	A	C	T	A	A	T	C	G	A	A	T	T	T	T	A	A			
SEQ ID NO: 49	cKa	T	C	A	G	T	G	C	A	T	T	C	G	G	A	G	C	A	A	C	T	A	A	T	C	G	A	A	T	T	T	T	A	A			
SEQ ID NO: 50	cSF	T	C	A	G	T	G	C	A	T	T	C	G	G	A	G	C	A	A	C	T	A	A	T	C	G	A	A	T	T	T	A	A				
SEQ ID NO: 51	Ka	T	C	A	G	T	G	C	A	T	T	C	G	G	A	G	C	A	A	C	T	A	A	T	C	A	C	A	A	A	G	A	T	G	A	C	C
SEQ ID NO: 52	SF	T	C	A	G	T	G	C	A	T	T	C	G	G	A	G	C	A	A	C	T	A	A	T	C	A	C	A	A	A	G	A	T	G	A	C	C

FIG. 13



Confirmation of identity of potential BPIV3/HPIV3 chimeras by TaqI digestion

Figure 6A



Figure_6B

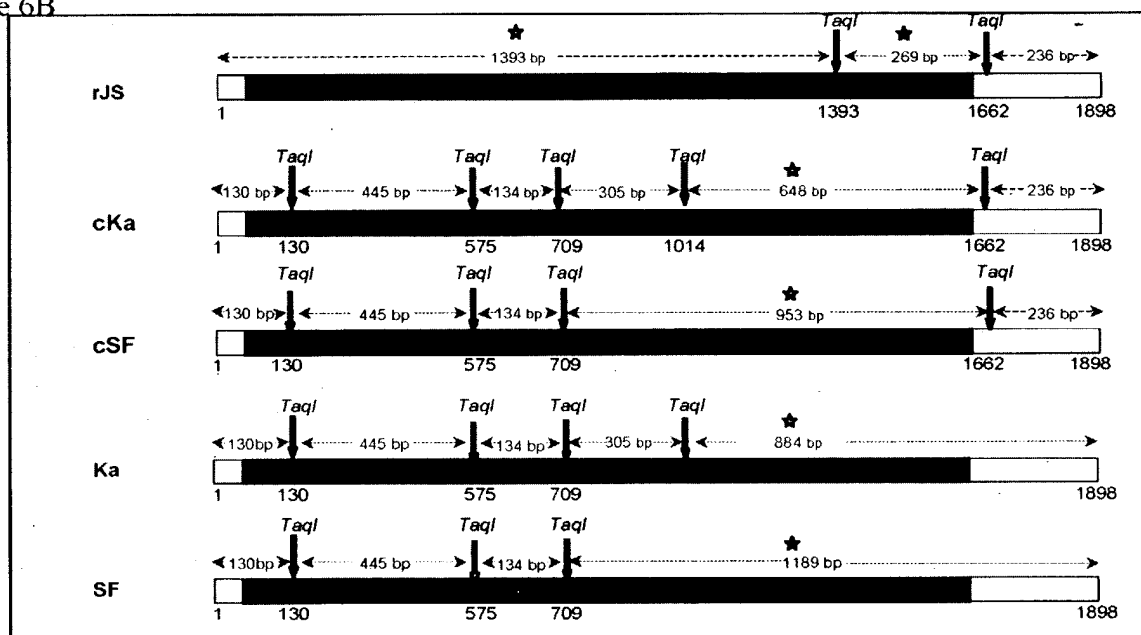


Figure 6C

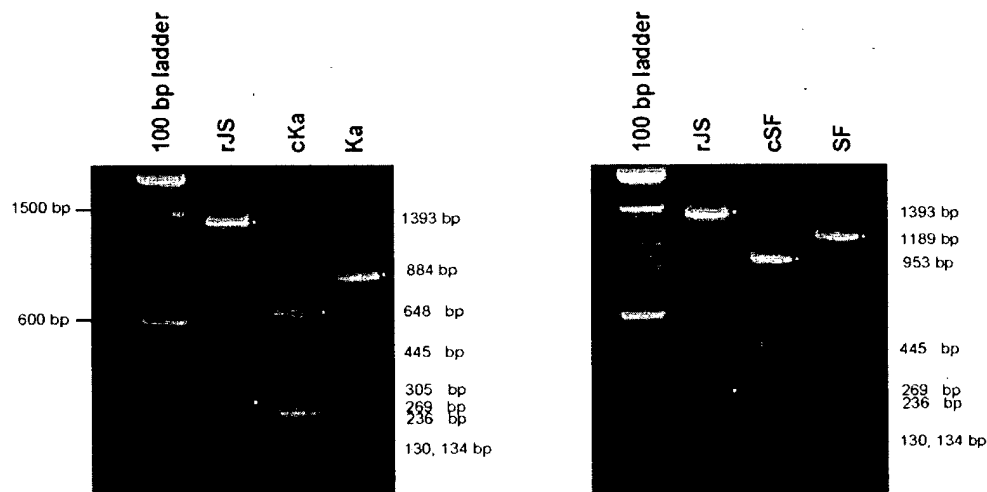




FIG. 7A

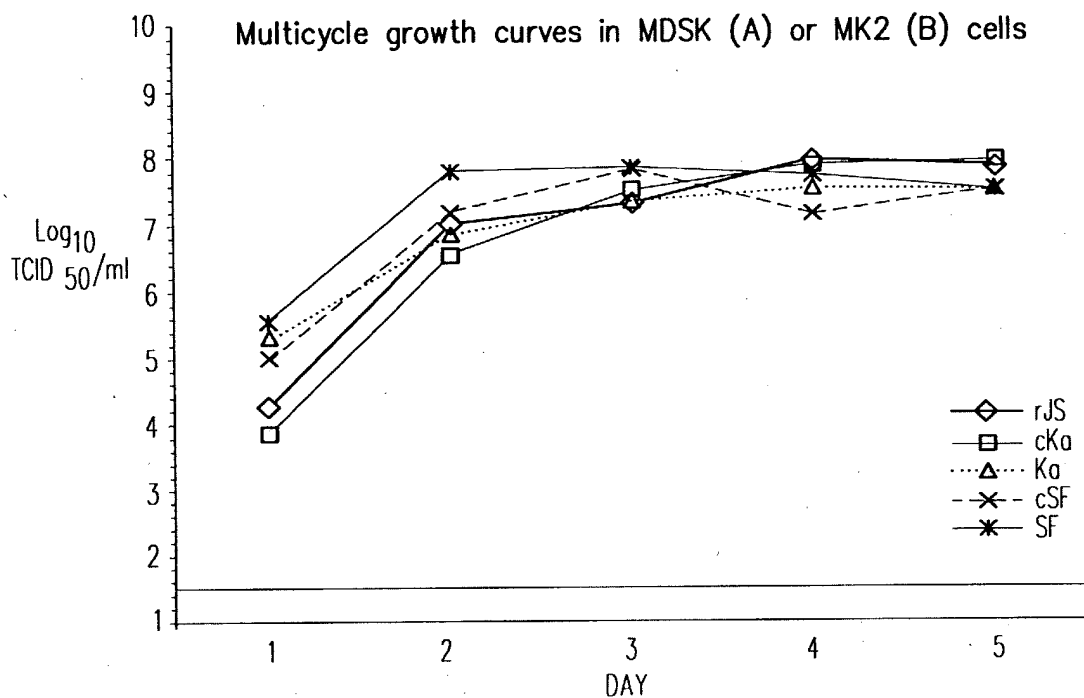


FIG. 7B

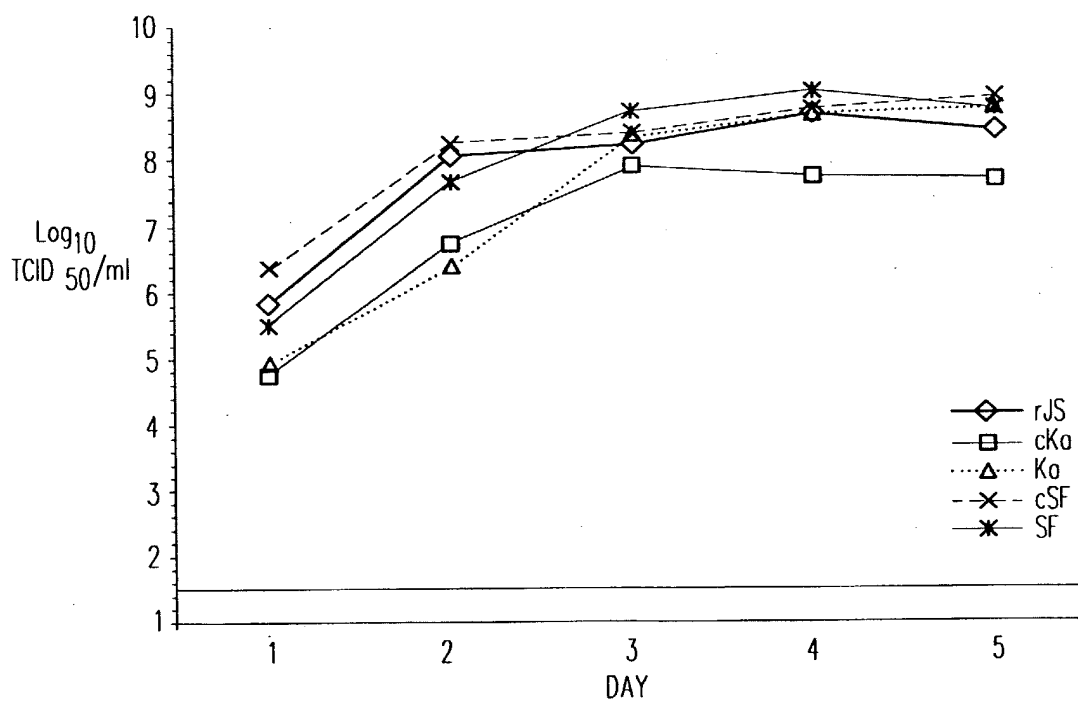




FIG. 8A

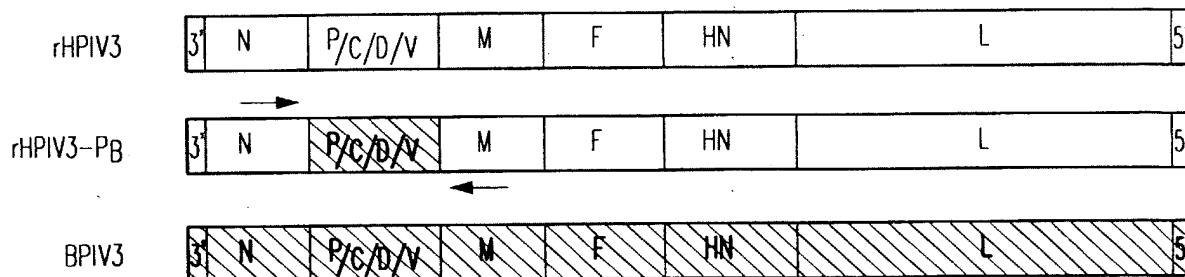


FIG. 8B

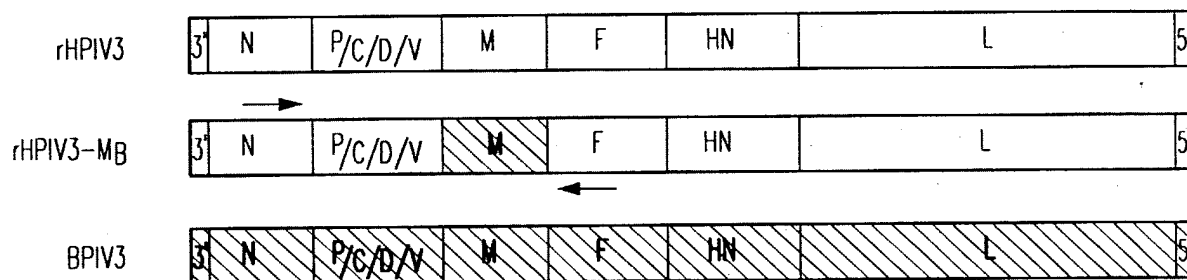
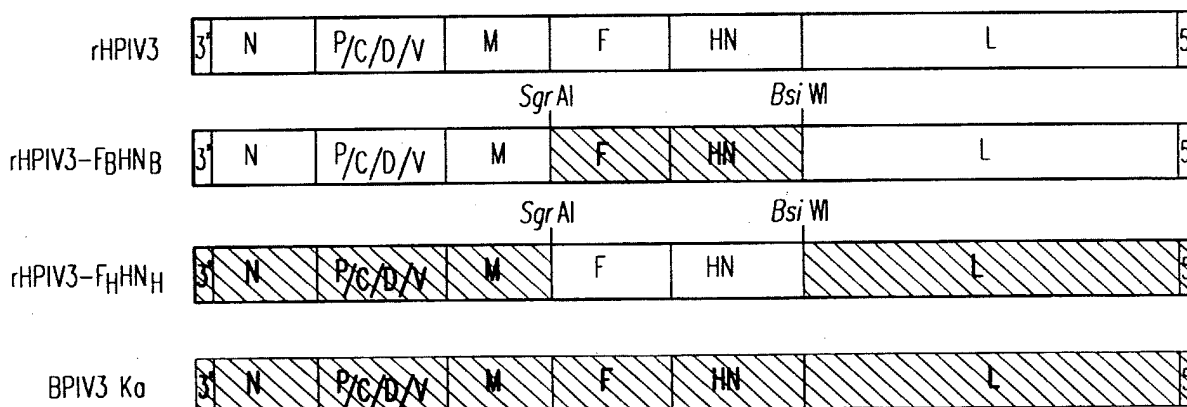
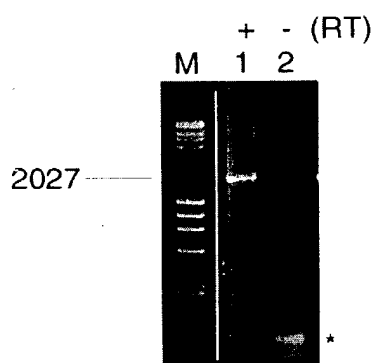


FIG. 11A



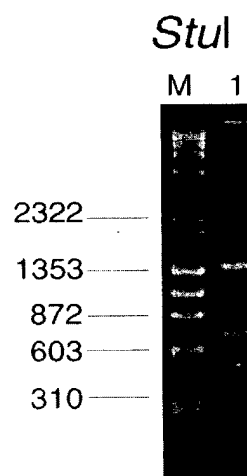
10/15/02
 jc965 U.S. PTO

Figure 9A



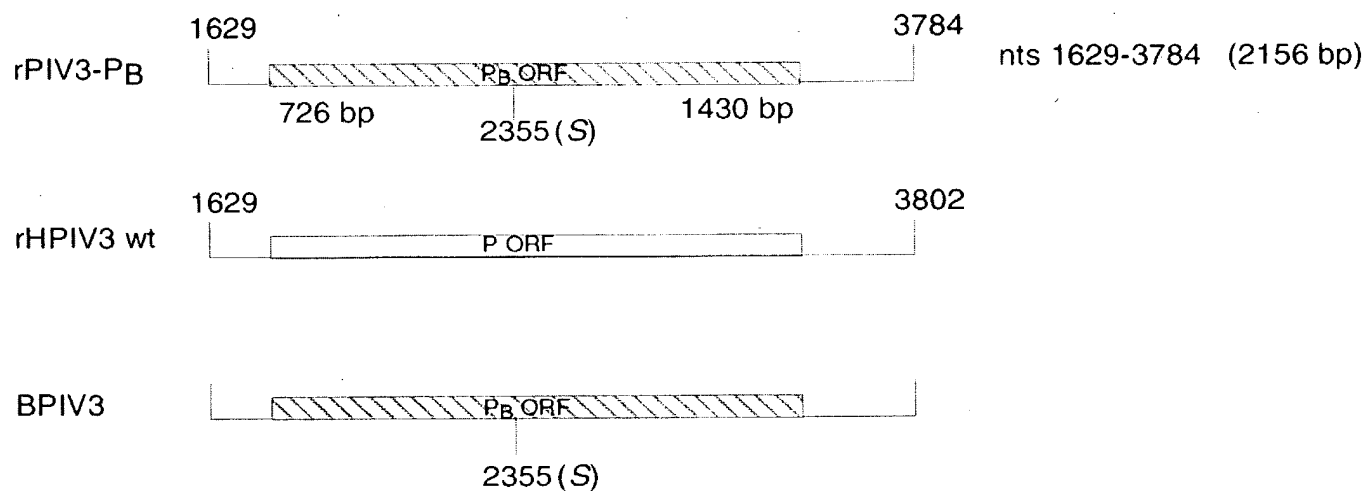
rHPIV3-PB

Figure 9B



rHPIV3-PB

Figure 9C



10/15/02
 Jc965 U.S. PTO

Figure10A

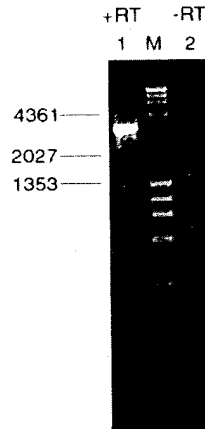


Figure10B

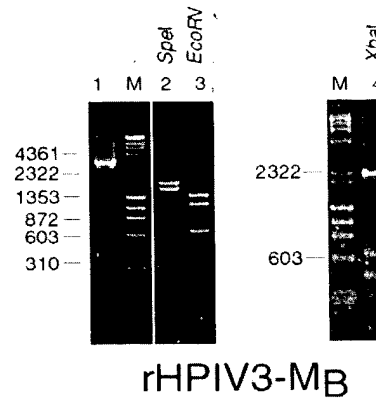


Figure10C

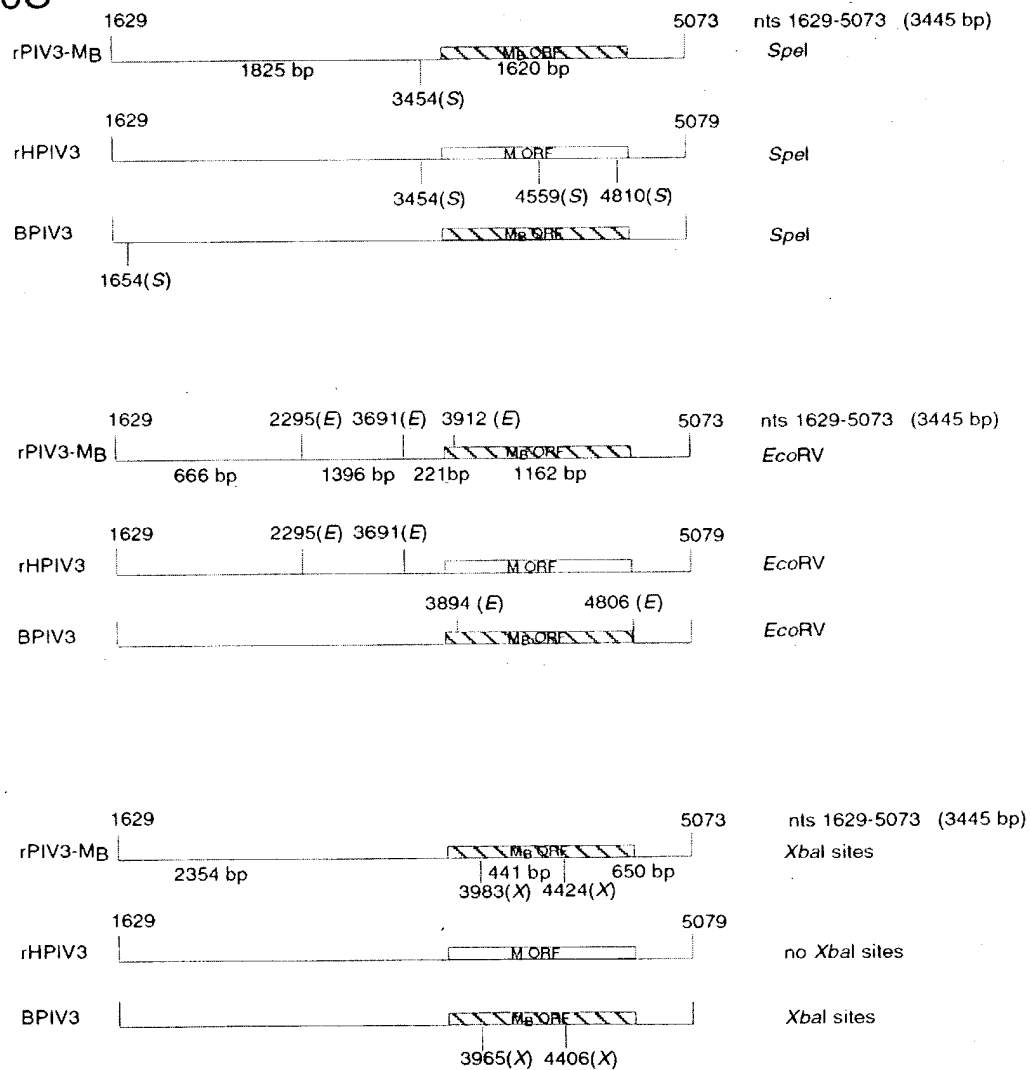


FIG. 11B

Assembly of an antigenomic cDNA for BPIV3 Ka

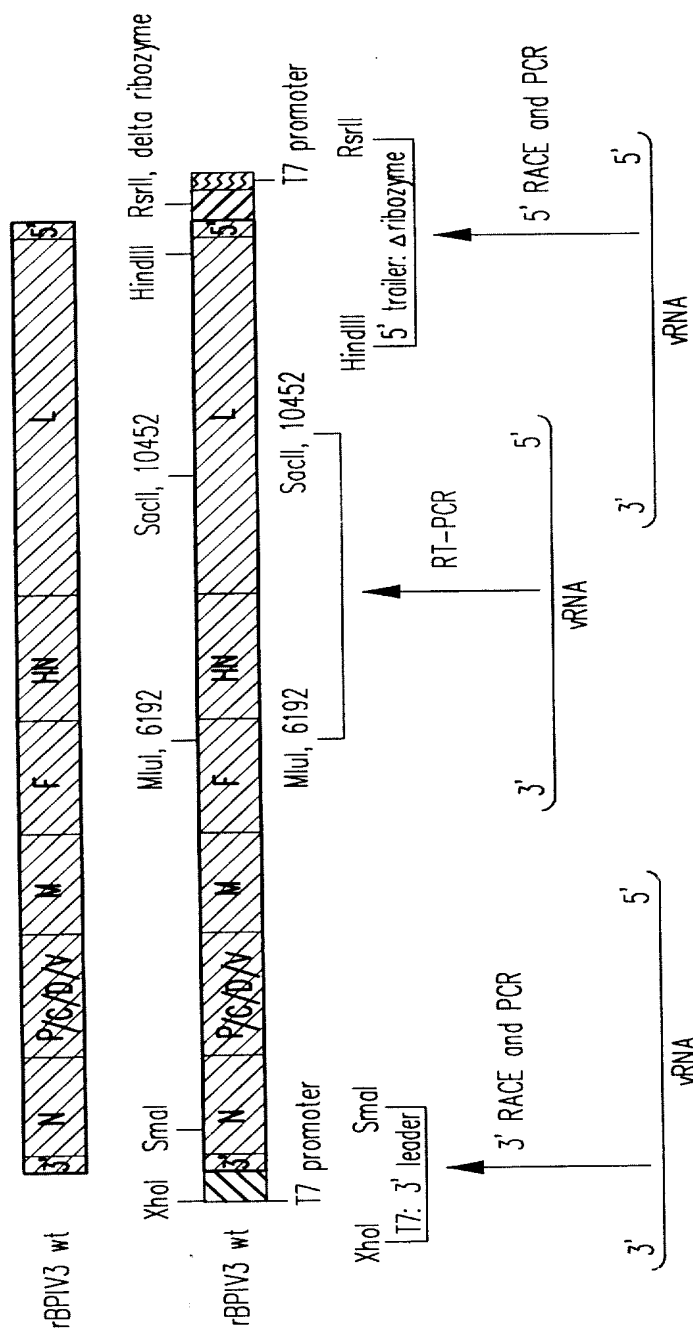
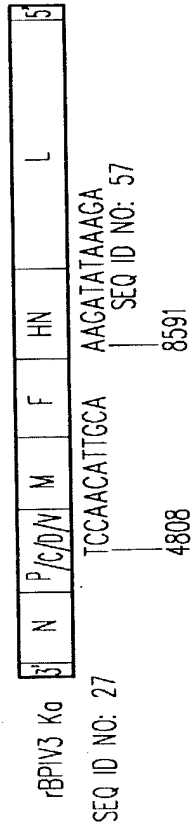
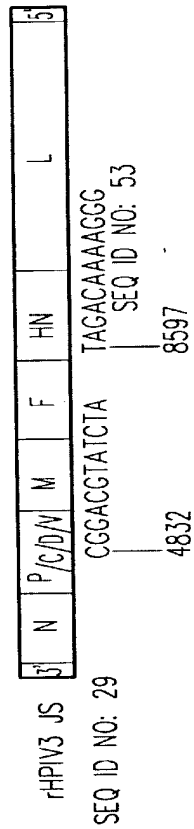




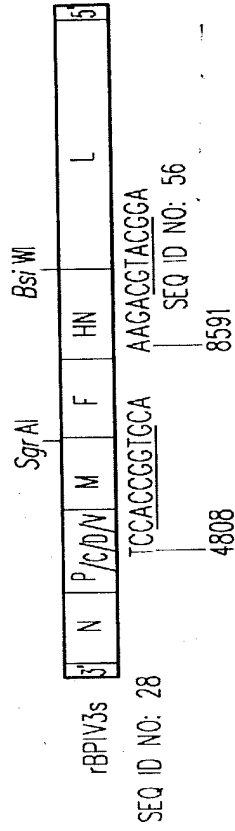
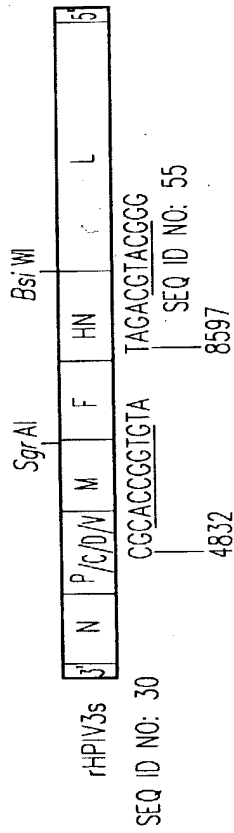
FIG. 11C

Generation of full length cDNA clones encoding HPIV3/BPIV3 antigenic chimeric viruses

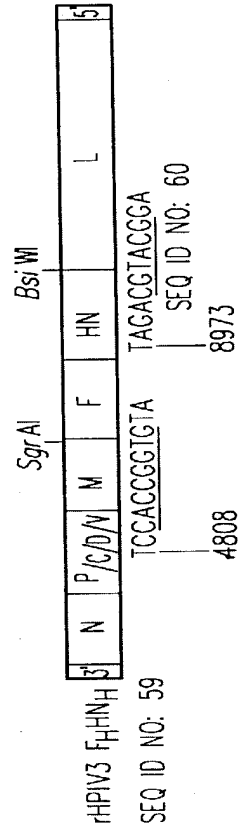
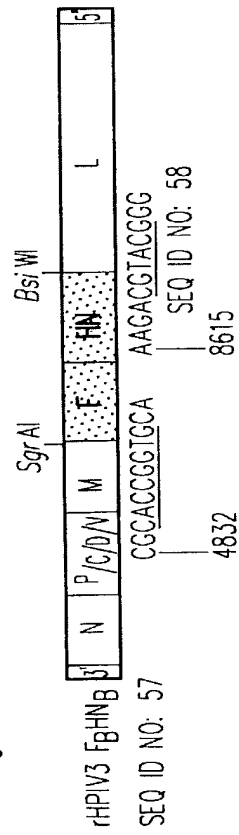
Generation of HPIV3 and BPIV3 full length clones



Mutagenesis to create unique SgrAI and BsiWI restriction sites

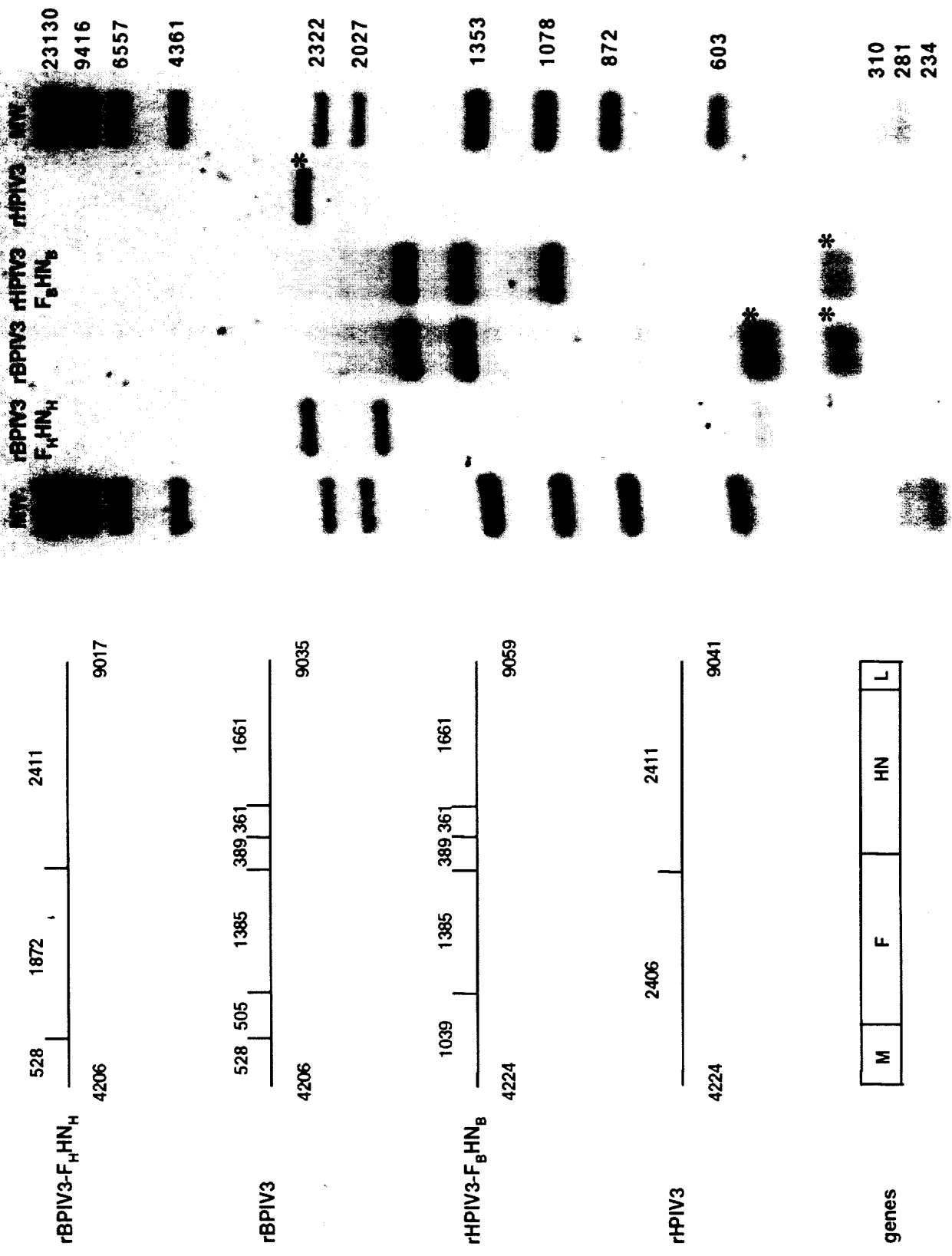


3. Cloning of the F and HN genes into the heterologous full length cDNA



SCANNED, #

Figure 12



M	F	HN	L
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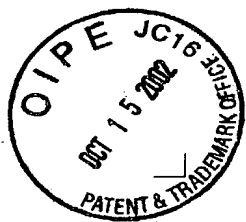


FIG. 14A

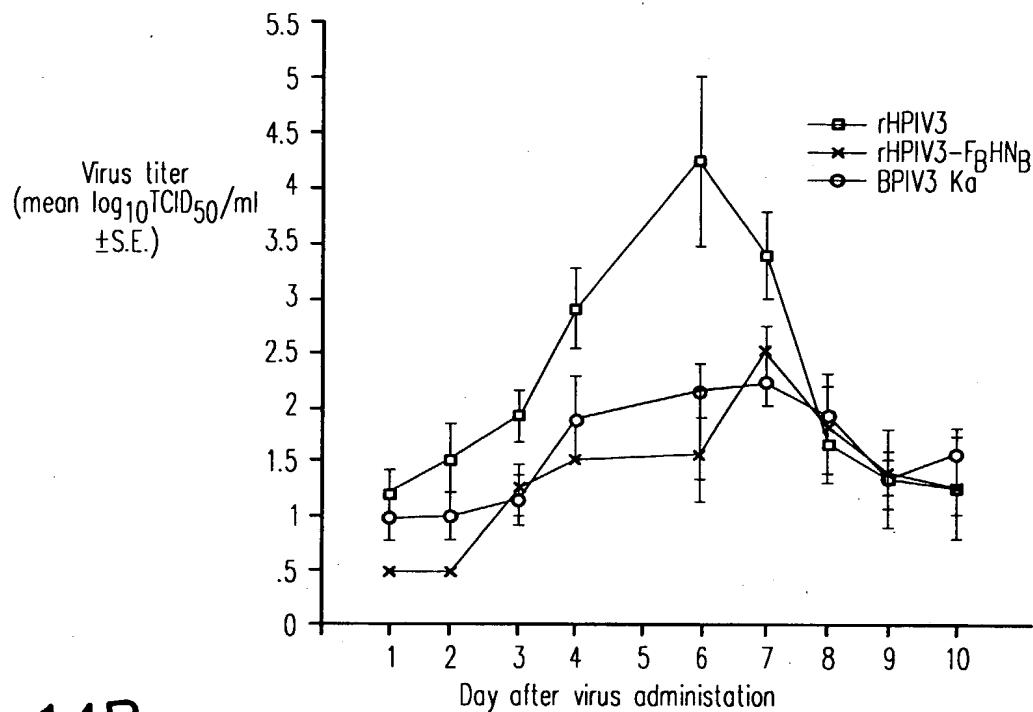
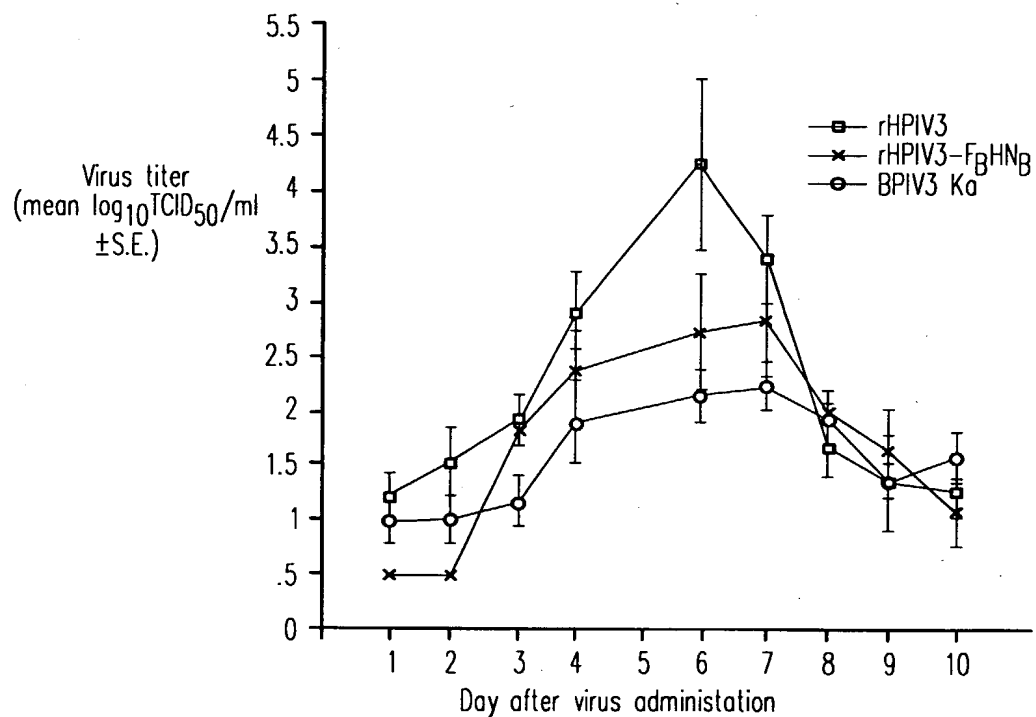


FIG. 14B



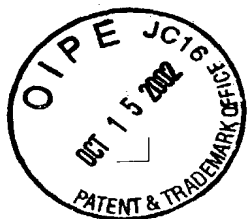


FIG. 15

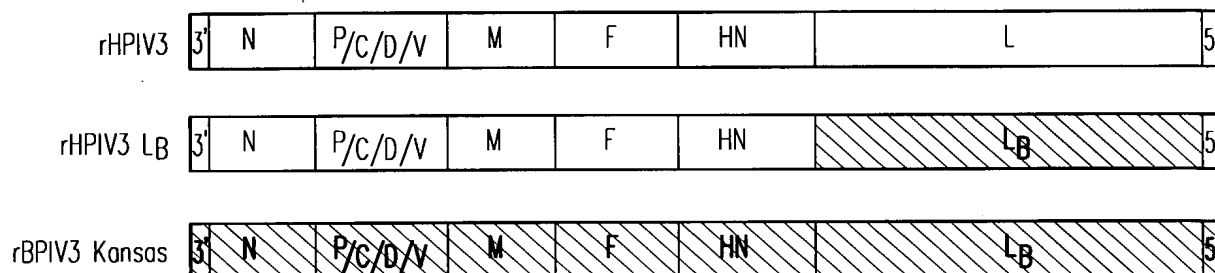


FIG. 16

L START

SEQ ID NO: 61	rHPIV3 WT	8623	5'	TAGGACCAAAGCGTGCTCGGAAATGGACACTGAATCTAACA	3'	8664
SEQ ID NO: 62	rHPIV3 Lb	8623	5'	TAGGACCAAAGCGTGCTCGGAAATGGACACCGAGTCCCACA	3'	8664
SEQ ID NO: 63	rBPIV3 wt	8617	5'	<u>TAGGAGAAAAGTGTGCAAGAAAAATGGACACCGAGTCCCACA</u>	3'	8658

L STOP

SEQ ID NO: 64	rHPIV3 WT	15325	5'	ATGATGAATTGATATCGATTAACATAAATACAATGAAGA	3'	15366
SEQ ID NO: 65	rHPIV3 Lb	15325	5'	<u>ATAATGAATTGATATTGATTAATACGTACGTACAATGAAGA</u>	3'	15366
SEQ ID NO: 66	rBPIV3 wt	15319	5'	<u>ATAATGAATTGATATTGATTAATACATAAAAAACATAAAAAA</u>	3'	15360